THE

ECONOMY OF THE EYES:

PRECEPTS

FOR

THE IMPROVEMENT AND PRESERVATION

OF

THE SIGHT.

PLAIN RULES WHICH WILL ENABLE ALL TO JUDGE EXACTLY WHEN, AND WHAT

SPECTACLES

ARE BEST CALCULATED FOR THEIR EYES:

OBSERVATIONS

ON

OPERA GLASSES AND THEATRES,

AND AN ACCOUNT OF THE

PANCRATIC MAGNIFIER,

FOR DOUBLE STARS, AND DAY TELESCOPES.

"Qui Visum, Vitam dat."

BY WILLIAM KITCHINER, M.D.

AUTHOR OF THE COOK'S ORACLE;
THE ART OF INVIGORATING AND PROLONGING LIFE;
THE PLEASURE OF MAKING A WILL;
OBSERVATIONS ON SINGING, &c. &c. AND
EDITOR OF
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Dr. Kitchiner is preparing for Publication,

THE ECONOMY OF THE EYES.

PART II.

HOW TO CHOOSE AND HOW TO USE

TELESCOPES,

OF ALL KINDS AND ALL SIZES,

AND FOR ALL PURPOSES.

The Illuminating and Magnifying Powers and Prices of Newtonian, Gregorian, Cassegranian, and Herschelian Reflectors, and Galilean, Huygenian, and Achromatic Telescopes, of from 3 Inches to 7 Feet Focus, being Calculated and Described in Plain Terms which all Persons may easily understand.—To which will be added, An Appendix from the Writings of Sir Isaac Newton, Sir William Herschel, &c. *and Original Communications from Eminent Practical Opticians of the present time, on the Construction and Use of Telescopes.*

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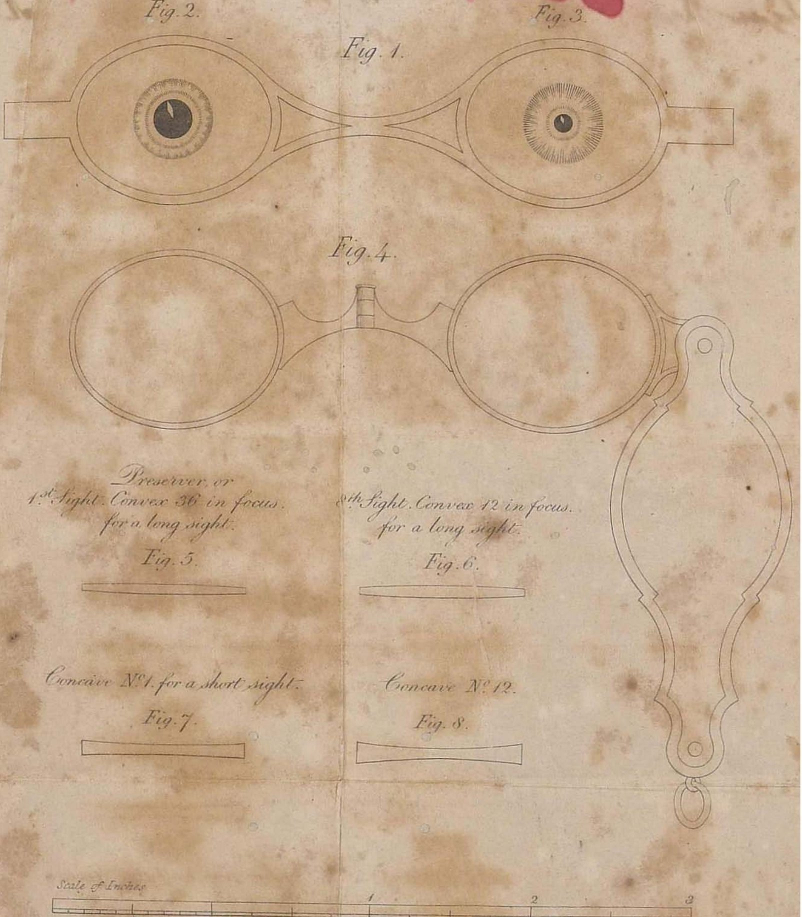

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PREFACE.

TO BE READ AFTER THE WORK.

Now, friendly Reader, before I take leave of You — after — Your deliberate perusal of this Volume,—if You vote that my labour has been lost, or has afforded you so little pleasure, that You begin to think You would rather have your Seven Shillings in your pocket again, than this first part of "*the Economy of the Eyes*" under your Chin,— allow me to suggest, that You ought to *Lend* it to every body You know — to prevent others being decoyed, as in such case You will suppose you have been — to buy a Book which is not worth reading.

But if it so happen that fortunately for the Writer, You think you have derived Amusement or Instruction from his Work, — if You are so good as to wish to be grateful for the Information which it has given you — LEND IT NOT—to one of those prudent folks who are in the habit of borrowing your new Books, and so contrive to become wise at your expense, — but do the Author the favour to recommend all your Friends to purchase it.

INTRODUCTION.

GENERAL OBSERVATIONS ON SPECTACLES.

WITHOUT SPECTACLES* all the other working tools, of most Artists, soon after their 40th year, would be almost useless.

At that precious period of Life, when Genius begins to wait upon Judgment,† the persevering Student would no longer be able to enjoy the fruits of the labours of his Predecessors, or to preserve the produce of his own for the benefit of Posterity.

* "Were there no other use of Optics, than the invention of *Spectacles* for the help of defective Eyes, I should think the advantage which mankind receives thereby, inferior to no other benefit whatever, not absolutely requisite to support Life."—MOLYNEUX's *Optics.*

† "The exact time when years have ripened *the Judgment*, without diminishing *the Imagination*, by good critics is held to be punctually at *Forty*."—See MARTIN SCRIBLERUS *on the Dunciad*, p. 55.

The accomplished Artist, almost as soon as he acquires his Art, would be incapable of pursuing it, — the seeds of perfection which he has been industriously cultivating during the First period of Life, would very soon after cease to be productive, and, but for the Eye-invigorating Art of the Optician, his latter days would be melancholy and forlorn.

It is hoped that by a little attention to the following pages, that All who can hear,* may be enabled to procure precisely such Glasses as are most proper for them.

Every body is in want of such Information, because Nobody has given it, — therefore, I have endeavoured to render it as easily attainable, as it is universally desirable, by communicating it in such plain terms that Every body may understand.

The choice of Spectacles is one of those acts which cannot be properly performed by proxy — the Sight cannot be perfectly suited, unless

"Every Eye negociate for itself."

---

* It is presumed, that the majority of the purchasers of this Work, cannot See! till they have learned how by the instructions herein given.

This is so absolutely true, that not only One Person cannot choose for Another — but One Eye has often very little notion what Glass will be best even for its own Brother, so extremely does the Left Eye occasionally differ from the Right.

No faculty of man varies more in its nature, or is susceptible of so high a degree of Improvement and Refinement by Art, as the Sense of Sight. The highest degrees of its discriminating power are acquired slowly and imperceptibly.

From organic imperfection and neglect of cultivation,* many People pass through Life who (it may be said, comparatively,) never See — *i. e.* whose Eyes never have the faculty of accurately appreciating either Form — or Colour: — to very few indeed is it given to perfectly perceive and portray both.

There cannot be a more evident proof of the

* "Every person acquainted with Optics and the nature of vision, knows that what is generally comprehended under the term *Seeing*, is a complex operation; an art acquired by degrees, in which judgment and imagination are concerned, together with simple perception." — Crisp *on Vision*, 8vo. 1796, p. 106.

general defect in people's Sight—than the general acceptance of capricious and unreasonable Fashions, which appear to be prevalent, in proportion that they are in direct opposition to all the principles of good taste, and which to a fine Eye, are frequently frightful, and absolutely painful to behold.

From the different modes of colouring of different Artists, I suppose that the Eyes of no two Painters feel exactly the same impression of colours,—and objects, appear of different Colours accordingly as they are illuminated with different Lights.

> "The Mole's dim curtain, and the Lynx's beam,"
>
> POPE.

do not differ more extremely than does the Sight of different persons—and of the same persons at different Ages.

The peculiar conformation of the Eyes, differs quite as much in different persons, as the construction of their Noses;—it is just as impossible to guess exactly what Spectacles will best suit the Sight of another Person, as it is to tell what Tunes are most delightful to his Ear,—or what Tastes are most delicious to his Tongue.

Nothing can be more erroneous than the common notion, that there is an invariable Rule, that *a certain form of Glass is calculated for a certain Age.* No Rule has more exceptions:—but this *Vulgar Error* has been productive of great and irremediable Injury to the Eyes of Thousands!

Hence, the grand desideratum, is to instruct people how to choose wisely for Themselves—which, I hope, even those who are totally unacquainted with the subject may do with the most perfect ease and accuracy, by the help of this Treatise, which is not published for the purpose of recommending some particular Oculist—or of persuading the reader that the simplest of all Optical instruments, spherical Spectacle Glasses, can only be purchased of One Optician:—is not a collection of crude conceits,—but is a plain impartial statement of all the Facts I have accumulated during my consideration of the subject for 30 years past—in which I have

"Nought extenuated, nor set down aught in malice."

My Motto, friendly Reader, is

"Truth, tempered by Good Humour."

> "Men must be taught as if you taught them not,
> And things unknown propos'd as things forgot.
> Without Good-Breeding, Truth is disapprov'd;
> That only, makes superior sense belov'd."
>
> *Essay on Criticism.*

I do not think it is my business—I am sure it is not my Pleasure, to register the various pretended improvements in Spectacles which have from time to time been proposed to the Public,—such as the Sympathetic Pebbles—which "as the Sight alters, they will alter also to the Sight, by which one pair will last the wearer for Life," &c. &c. &c.!!! This would be irksome to the Writer, and useless to the Reader.—I shall only mention the most remarkable.

In 1785, *Mr. B. Martin* published a pamphlet recommending what he called

"VISUAL GLASSES,"

the use of which, he assures us, would be "productive of peculiar advantages,"—they might be—but, by Mr. Adam's account, not to the gentlefolk who bought them.

"The desire men have to increase their

Business, and extend their Fame, has, in many instances, been the origin of alterations and inventions,—injurious to Science and detrimental to the Public.

"To this we may, with propriety, impute the invention of *Visual Spectacles.* But the good sense of the world, which always, in the long run, justly appreciates the value of every invention, now leaves Visual Spectacles to the neglect they merit."—G. ADAM's *Essay on Vision,* 8vo. 1792, p. 113.

I beg to be excused saying more, than that I do not think that any of the Spectacle Glasses which have come before my Eye, have any superiority over the Common Spherical Lenses now in general use.

In instituting Experiments for ascertaining the distinctness and brightness of Spectacle Glasses—be extremely careful, that the Glass is not only of exactly the same quality, but also of exactly the same Focal length—or any attempt at comparison will be useless.

If one of the Glasses be only of a very little shorter focus than the other — objects will always make a very different, and sometimes a much stronger impression on the Eye.

To measure the Focal Length of Spectacle Glasses, see Chapter xv.

To give my Readers all the satisfaction in my power,— I have added an APPENDIX — which contains sufficient corroboration of what I have asserted on certain important points,— because — by the time Persons want Spectacles, they have generally become wise "in their own conceit,"— and have picked up a parcel of silly prejudices concerning them, which unless completely counteracted, and rectified by the invariable standard of irresistible Truth,—will prevent their deriving that benefit from this publication, which the Author heartily wishes that they should receive to the utmost extent.

I have given Rules for the choice of Glasses as relates to their degrees of Magnifying,— and have also pointed out those criterions by which All may judge if the Glasses are good — and of the right focus — and readily discover those imperfections in them which are so common, and so injurious to the Eyes.*

* See Chapter xvii. "*Of the Quality of Spectacle Glasses,*" and the Note at the foot of page 40.

To effectually eradicate erroneous opinions, and to establish the Truth beyond all doubt, I know is no easy task — therefore, I have given an Appendix of Quotations from the best Authors on the subject — the correctness of whose Judgment has been established by Experiment, and has been pronounced indubitable, by universal acceptance — *i. e.* from the Writings of Dr. Smith; — Dr. Jurin; — Dr. Porterfield;—Dr. Blagden;—Dr. Wells;—Dr. Herschell; — Mr. G. Adams, the Optician; — the late Mr. Ware, the Oculist; — and Mr. Stevenson, the Oculist; — and for many valuable facts, I am indebted to that experienced Optician, Mr. Samuel Pierce, who was upwards of Thirty Years with Mr. Jesse Ramsden.

"Palmam qui meruit, ferat."

There could not be a more useful Charity — than that of providing proper

SPECTACLES FOR THE POOR.

The Best Glasses, set in Single-Jointed Steel Frames, may be purchased wholesale at the rate of 18s. per dozen Pairs; — if a Single-jointed frame is fastened round the head with

a Riband, it may be kept on, almost as steadily and comfortably as a Double-Jointed Frame.

For the small sum of 18 Pence the Benevolent may enjoy the gratifying reflection of giving an industrious Workman the power of long continuing his labour with undiminished Ability, and of earning a subsistence till extreme Old Age.

In no way—can so much Good be done with so little Money!

"Qui Visum, Vitam dat."

The greatest part of the Disorders of the Eyes of Poor People who are upwards of 45 years of Age, are occasioned by their straining their Sight for want of Spectacles,—or by looking through Bad Glasses,—or those of a Focus not suitable to their Eyes:—I hope when this is considered by THE OVERSEERS OF THE POOR,—THE DISTRICT SOCIETIES FOR BETTERING THE CONDITION OF THE POOR, and the Patrons of THE EYE INFIRMARIES, that they will make the distribution of Spectacles a part of their Bounty.

CHAPTER I.

ON READING GLASSES,

For Persons whose Eyes are impaired by Age — and Single Eye-Glasses for the Short-Sighted.

When would-be-thought-young Persons, first feel the necessity of giving their Eyes Optical assistance, they are, nevertheless, shy of mounting *Spectacles*, which they seem to consider an inconvenient manner of advertising their Age upon their Nose — not reflecting that they are worn by many persons who have not seen half their years, but who being *Short Sighted*, are obliged to walk about in Spectacles, or forego the sight of "the Human Face Divine."

However, they suppose that Spectacles are such unequivocal evidence of Age and Infirmity— that they desire to dispense with exhibiting them as long as possible—therefore, they purchase "a Reading Glass," and habitually put it up to One and the same Eye, leaving the other involuntarily to wander ; — after a few years, the sight of the Idle Eye becomes of a

different focus to that which has been employed with the Glass — and is often irreparably impaired.

" These puerile propensities, give rise to a variety of artifices, by which each individual endeavours to hide from himself and others, what no artifice can conceal, and which every one can discover, in all but himself; — these endeavours often contribute to hasten the Evils they are meant to conceal. Opticians have daily experience of the truth of this Observation, and in no instance more so than in the preference given by many to *Reading-Glasses*, (under whatever pretext it may be covered) merely because they think that the decay of their Sight, and their advances in age, are less conspicuous by using *a Reading-Glass*, than *Spectacles*: but the Eyes in endeavouring to See with a Reading-Glass are considerably strained, and in a short time much fatigued: and there is another objection to the use of Reading-Glasses, which arises from the unsteadiness of the hand, and the motion of the head, which occasion a perpetual motion of the Glasses, for the Eye endeavours to conform itself to each change, and this tender organ is

thereby kept in continual agitation: to these evils we may add the dazzling glare and irregular reflexion from the surface of the Glass, which so weakens the Eyes, that those who accustom themselves to a Reading-Glass, are in a short time obliged to take to *Spectacles*, and to use them much older than they otherwise would have done."—Mr. George Adams *on Vision*, 8vo. 1789, p. 115.

When persons who have long patronized One Eye, and slighted the Other, take to Spectacles, they will (generally) require Glasses of a different focus for each Eye.

When You go to an Optician's to choose Spectacles, the first thing to attend to, is to look at a Book with each eye alternately,—and carefully ascertain, if You see equally well, with both Eyes, with the same Glass, at exactly the same distance.

Inequality of the focus of the Eyes, is much more common than is generally supposed, as Watchmakers, Engravers, and most Artists who work with a Magnifier, will tell you; they generally work with One and the same Eye—with which, they can see much better than with the other.

After a certain Age, the relative sharpness of the sight of the Eyes, varies as much as does the quickness of the Ears — the Senses of *Hearing*, — and of *Seeing*, begin to fail about the same time; — there are few people past 40 who cannot hear better with One Ear, than they can with the Other.

The Eye least used, soon becomes weak, and in the course of a little time almost useless. — This fact, is so little known, that I have frequently heard persons who up to the age of 40 have worked their Right Eye — and finding it begin to fail, say, they must begin to teach their Left Eye to See — however, as I told them, they found on trial, that the Eye which had been Idle, was much more impaired than that which had been active.

> "By ceaseless action all that is, subsists."
>
> COWPER.

SPECTACLES are always preferable, because both Eyes* by being kept in action, are kept in Health — Vision is brighter and easier, and the labour of each Eye is considerably lessened.

* To ascertain whether an Object seen with *Both Eyes*, appears *brighter* or *larger*, than when seen with *One Eye*

As the Eyes of Persons who have either a very *Long* or a very *Short* sight, are useless without Optical assistance—they should have Double Folding Spectacles slung round their neck; (See Chapter IV. and Figure IV. in the Plate fronting the Title); or, if they will have a *Single Eye-Glass*—let them take care to use it without partiality—and put it to Each Eye alternately.

A Single Glass, set in a smart Ring, is often used by Trinket-fanciers merely for Fashion's sake, by folks who have not the least defect in their Sight,—and are not aware of the mischievous consequences of such irrita-

only, Dr. Jurin made several experiments, which are too long to insert more than the results of them.

"This difference was most conspicous, when in making the experiment by candle-light, the book was at such a distance from the candles as that there was scarce light enough to read with both eyes; when the column which was seen by One Eye only, was not at all legible; but I could read with both; though with some difficulty.—See Dr. Smith's *Optics*, 4to, vol. ii. p. 107 of Remarks.

"Though the Letters of a printed book appeared brighter and stronger—yet they do not seem at all larger when viewed with *Both Eyes* than when seen with *One Only*."—See Dr. Priestley *on Vision*, 4to. 1772, p. 669.

tion:—this pernicious plaything will most assuredly, in a very few Years, bring on an imperfect vision in One or Both Eyes.

Notwithstanding all the experience collected during the preceding 42 Years—*the Third act of Life, i. e.* from 42 to 63—is as seldom performed properly, as either of the former. "*The Art of Growing Old with a Good Grace,*"—I believe, is one of those, which the Ancients termed "Occult Arts"—and it appears to be almost as little understood, as that of communicating to our speedily perishing Body, the unchangeable nature of the incombustible Asbestos.

Query. Which appears most ridiculous? A Young Man pretending to the Sagacity and Experience of Age—or an Old Man affecting, the Strength, and Apeing the Alertness of Youth?

The only way that Persons can indulge their humour of appearing Purblind with impunity, is to use—

MAHARAJA SERFOJI'S SARASWATI MAHAL TANJORE

CHAPTER II.

SPECTACLES WITH PLAIN GLASSES.

THESE should be kept by all Opticians, — who are not seldom puzzled and plagued by more nice than wise folks, who without any need of Spectacles, yet hearing their acquaintance talk of how charmingly they can see in Glasses, they long, like "the Italian Count,* to be better than well" — and will not believe, that although they have not the least occasion for Optical assistance, yet, without trying all sorts of Glasses, cannot be convinced, that however this branch of Optics may alleviate the infirmity of the Eyes, as a Hearing Trumpet does that of the Ear, yet that when the Eyes are in a healthful state, they can receive no more assistance from Glasses, for the ordinary purposes of the Sight — than a person who is not Deaf can from a Hearing Trumpet — which, although so serviceable to a person who is deaf, is not of the least use to one who is not deaf.

* Whose Epitaph is — "I was well — wished to be better — Took Physic — and Died."

"Why has not man a Microscopic Eye?
For this plain reason, Man is not a Fly.
Say what the use, were finer Optics given
T' inspect a Mite, not comprehend the Heaven!
God, in the nature of each being, founds
Its proper bliss, and sets its proper bounds.

Pope.

That ingenious Optician, the late Mr. Jesse Ramsden, informed me, that he had ofttimes more trouble to make obstinate and ignorant persons understand that the Art of Optics could not be of any service to them, than he had to find Glasses for correcting the most eccentric aberrations from good Vision — and that he found the only plan of completely convincing such troublesome Customers was, after he thought that they had sufficiently amused themselves with trying a variety of Glasses, — and had tired him, — to give them a pair of Spectacles glassed with plain Glass — when they would cry out with rapture — "Aye, these will do, I can see charmingly in these — why — why didn't You give me these at first?!!!"

Nothing, short of such ocular demonstration, could satisfy them.

CHAPTER III.

CASE OF A PERSON WHO COULD NOT READ IN SPECTACLES.

Mr. R. told me that he was once strangely puzzled, by a clever Old Gentlewoman of 79 years of age, for whom he was requested to make a pair of Spectacles. — She had applied in vain, to several eminent Opticians, and no Glass could be found that improved her Sight.

With all that Ambition to overcome difficulties, which was the ruling passion of Jesse Ramsden, he waited upon the Lady, with several pairs of Convex, and of Concave Spectacles, making quite sure, that however others had failed, he should succeed, and enjoy one of those triumphs, which constituted the Zest of his Existence, — but after patiently trying every one of them, She said with a Sigh! — "No, — not one of these will do — I can see better with my Naked Eye. Well! what an unfortunate Creature I am, at my Age, not to be able to see to read in Spectacles!!"

Jesse consoled the Good Lady as well as he

could, by observing, that many at her advanced age could hardly see at all; and that although she could not see to read —— Here she interrupted him with sufficient vehemence, and, to his extreme astonishment, exclaimed, — " Sir, You are strangely mistaken, Sir! — I did not tell you that I could not see to Read, Sir! — I can see to Read, Sir, as well as ever I could, — I only complained that I could not see to read in Spectacles!! *I can see to read very well without!!!* but my Acquaintance say how charmingly they can see with Glasses, and surely, it is very hard that I cannot enjoy the same Advantage."

CHAPTER IV.

HAND SPECTACLES

ARE infinitely better than any Reading Glass,* however large it may be, — but are still, not so comfortable to the Sight as *Spectacles on Nose* — unless considerable care is constantly

* " The *Single Convex Glasses* with which some Persons read, must be very injurious, if they be sufficiently large to

taken to always hold them exactly parallel with, and at exactly the same distance from the Eyes.

Double Folding Hand Spectacles (see Figure IV. in Plate facing the Title) are preferable to *a Single Eye-Glass,* for *Short-sighted* persons to view pictures, &c. &c. Moreover, the use of them is not so likely to be set down to Impertinence and Affectation — a census which all persons expose themselves to, as often as they stare about them with "*a Quizzing Glass.*"

The ingenuity of the Optician is often displayed in the formation of Hand Spectacles, and a variety of highly-finished Gold and silver mountings have been contrived — but unless the Glasses are defended by a case, as in the frame portrayed in Figure No. IV. in the Print facing the Title, they will soon

admit the same object to be seen with both Eyes. For as both axes will then pass through them, one on each side of the centre, the interval of the pupils will be widened, and the refracting power of the Eyes be diminished; so that here a disadvantage is to be added to the prejudice of the convexity of the Glass,—not a benefit to be placed against it, as in the case of Common Spectacles for the Long-Sighted." — Dr. W. C. Wells *on Vision*, 8vo. 1792. p. 130.

become scratched and spoiled. The Pearl frame is the most elegant.

CHAPTER V.

SYMPTOMS OF THE EYES REQUIRING SPECTACLES TO READ WITH.

THE natural decay of the Sight commences, in Common Eyes, very soon after "the Meridian of Life," which, according to those who train men for Athletic Exercises, and according to DR. JAMESON,* is about our 28th,—according to others,† about our 35th Year.

"*The Crystalline Humour* is clear, and transparent like water—till about the 25th or 30th year of our age, when it begins to become a little Yellow towards the centre, which Yellowness grows gradually deeper and deeper, and extends more and more towards the

* See Dr. J. *on the Changes of the Human Body*, 8vo. 1811, p. 89.

† See 4th Edition of "*The Art of Invigorating and Prolonging Life*," by the Author of this Work, 12mo. 1822, p. 46.

surface, in so much that Dr. Petit found that the Crystalline of a man 81 years old, resembled two pieces of beautiful Yellow Amber." — Dr. Porterfield *on the Eye*, 1759, 8vo. vol. i. p. 229.

The commencement and progress of the deterioration of the Sight, depends upon the health of the individual — upon the original formation of the Eye, — and upon how it has been used.

Some Eyes, at 30 years of Age, require the aid of art as much as others do at 50, — while the Sight of some persons continues almost as perfect at 50 as it was at 30.

The average period of the Eyes requiring Spectacles to read with, is about the 45th year.

Nature has decreed, that soon after our 40th year, the most perfect Eyes shall no longer retain the privilege she gives to Youth, of the power of adjusting them to See distinctly at different distances: — this range of accommodation diminishes gradually, till it fails almost entirely — those to whom it is given to continue to discern distant things distinctly, — no longer see those which are near distinctly.

Very few persons past the age of 40 can see quite so well by Candle-light, as they could

before that Age — those who can, — will generally find that there is a small degree of *Shortness* in their sight, which is the cause of their possessing that advantage longer than persons in general do — if they will try that very shallow *Concave* which is called, by Opticians, "*No. O. Concave,*" or "*Half a Number*" — they will find it give a decided outline to distant objects, which they never saw defined sharply before.

However, people who do not use their Eyes for minutely examining Near, — or for accurately delineating Distant objects, — are quite unconscious of the finer perceptions of a fine and cultivated Eye — and are equally insensible to the smaller gradations of the deterioration of their Sight, and happily suppose that "they have a Good Eye," while, as *Beatrice* says,

"They can see a Church by Day-light."

There are several symptoms, too evident, even for the Self-love of the vainest and the weakest to mistake, by which All persons will easily perceive when they really require the assistance of Spectacles.

The first Indication of the Eye beginning to be impaired by Age, is that when *You wish to read*

a small print, You are obliged to remove it further from your Eye than You have been accustomed to do, and desire the aid of plenty of Light; and on looking at a near object, it becomes confused, and appears to have a kind of mist before it, and the letters of a Book run one into another or appear double, &c.; and, BY CANDLE-LIGHT,* You catch yourself holding a Book, &c. close behind the Candle — and, that you begin to admire the ingenuity of the Gentleman who invented Snuffers.

You will begin to feel the absolute necessity of using Glasses, when you want to read a small print by Candle-light, for Twelve months before you require their assistance by Day-light. — See *Cumumbra Lamp.*

* "There are many who find the effect of *Candle-light* so different from the purer light of *Day,* that they are obliged to use Spectacles by night, though they can do very well without them in the day. These, when the eye has become more flat, will find it advisable to have two pair of spectacles, one to use by day, the other appropriated for the night: by this means, nearly the same quantity of Light may be brought to act upon the retina at one time as the other; thus the eyes will be less fatigued, and longer maintain their natural Vigour." — Mr. G. ADAMS *on Vision,* 8vo. 1789. p. 108.

If You obstinately strive against Nature, and barbarously refuse your Eyes that assistance from Art — which will enable You to see with great ease, but without which, you cannot see without great difficulty — You will act as absurdly, as if You refused to eat when hungry, or to sit down when You are tired — and will soon strain and weaken your Sight, which will receive more injury in a few Months by such forced exertion, than it would in Years, if assisted by proper Glasses which render Vision easy.

However, some people seem to be about as unwilling to acknowledge this Truth — as they are to confess that they do not feel quite so frisky at 45 — as they did at 25.

The common objection which people make to put on Spectacles, is, that "if They once begin to wear them, They are afraid they can never leave them off again:" this is true enough; — but why should they? if by such aid, their Sight is relieved and preserved, and They are enabled to see easily and distinctly, and when they attempt to read without, their Eyes ache, — their Head aches, — and every bit of 'em aches.

A man afflicted with incurable Lameness, who cannot move without Crutches, would act just as wisely, in refusing to avail himself of them,—because he can never hope to walk again without.

"Timely assistance from Glasses will ease the Eyes, and in some degree check their tendency to grow flatter—whereas, if they be not assisted in time, the flatness will be considerably increased, and the Eyes be weakened by the efforts they are compelled to exert; all delay is dangerous, and the longer those who feel the want of assistance, defer the use of Spectacles, the more they will increase the failure of the Eye."—ADAMS *on Vision*, 1792, 8vo. p. 109.

"The change in the conformation of the Eyes, which renders Spectacles useful, seems to be one of those which Nature has destined to take place at a particular period of Life, and to which there is no gradual approach through the preceding course of Life. A person for instance at 40, sees an object distinctly, and at the same distance that he did at 20. When he draws near to 50, the change I have spoken of, commonly comes on, and obliges

him in a short time to wear Spectacles. As it proceeds he is under the necessity of using others of a higher power. But, instead of supposing that his Sight is gradually becoming worse, from a natural process, he attributes the increase of the defect in it, to his too early and frequent use of Glasses. Upon the whole, I should draw this inference from what has been said, that — *no person whose Sight begins to grow Long, ought to be in the least prevented from enjoying the immediate advantage which Spectacles will afford him, by the fear that they will ultimately injure his Eyes.*" — Dr. Wells *on Vision.*

CHAPTER VI.

OF PRESERVERS.

By the help of *Convex Glasses** of 36 or 30 Inches focus, if your Eyes are in the state above mentioned, You will be enabled to read with the same ease, and at the same distance,

* Of *Convexes,* — *i. e.* Glasses for assisting those Eyes which are too *Long Sighted* — or what is commonly called

that you did before your Sight was altered by the inevitable decrees of Old Time — such Glasses, will make things appear clear, and distinct as they did before your Eyes were impaired; and if judiciously chosen, lessen the labour of the Eyes — and enable them to do their work with more ease, and therefore, I suppose, do, in a certain degree, preserve the Sight.

This Title of PRESERVERS, which some sagacious name-giver gave to Spectacles of 36 Inches focus or *the First Sight*, is an admirable appellation to attract the attention of people — but is equally applicable to all the following gradations of Glasses; — for the term is generally misunderstood, — people seem to suppose, that Spectacles of 36 Inches focus, have the magic power of arresting the progress of that failing of the faculty of Sight,

an Old Sight, are named from their focal length; the highest number, No. 36, magnifies least, and is called the 1st Sight: See Figure 5 in the Plate facing the Title.

Of *Concaves, i. e.* Glasses for a *Short Sight*, — that which is the least concave, and gives the least assistance to the Eye, is called No. 1. See Figure 7 in the Plate fronting the Title.

which is one of the natural and unavoidable consequences of Age.

When once the Sight begins to fail, it continues to decay, till in extreme Age, our Eyes, like our other Senses, — become of almost as little use to us, as they were in our Infancy.

It is very common for Persons after they have worn Spectacles of 36 Inches focus for a Year or two, to complain that they think that "their Glasses cannot be of the right focus for their Eyes, for when they do not wear them, they certainly cannot see so well without them as they did before they used them, therefore, — they certainly cannot be *Preservers*."

After the process of deterioration has been proceeding for 12 months — it would be wonderful if it had not made some perceptible progress! — It is as ridiculous, to expect that it is in the power of an Optical Instrument to entirely prevent the Eye undergoing that invariably certain, although almost imperceptible change which accompanies the advance of Age, as it would be to suppose that Art can prevent the failing of any of our other faculties.

I make these remarks, because, I know that the prepossessing term has induced some ex-

cellent Artists,* who were naturally extremely anxious about their Eyes — (their Eyes are their Estate, the mainspring of their Fame and of their Fortune) — to wear Spectacles before they wanted them.

Mem. — *The premature use of Spectacles,* is as pernicious to the Sight, as Physic to the Stomach of a Man in Health, and as absurd, and as uncomfortable, — as it would be to put on a Fur pelisse at Midsummer, as a *Preserver* against your feeling the Cold of Christmas.

* See Chapter xiii. The Art of Seeing, &c.

CHAPTER VII.

TABLE

Of the Focal Length of the Convex or Magnifying Glasses commonly required at Various Ages.

Years of Age.	*Inches Focus of Convexes.*	*Remark.*
40	36	Convex Spectacles are seldom wanted, except to read by Candle-light till 45 or 50.
45	30	
50	24	
55	20	
58	18	
60	16	
65	14	
70	12	
75	10	
80	9	
85	8	
90	7	
100	6	*

The above Scale was given to me by an eminent Optician, as the average results of upwards of 50 Years' very extensive Experi-

* These three last deep Lenses are very rarely required except for *Couched Eyes.* "One focus is seldom sufficient

ence :—and I believe it is as good a General Rule as can be written; but, as I have ob-

to enable those who have undergone the operation of *Couching*, to see objects at different distances — who generally require one pair of Spectacles for near, and another for distant, objects. The *foci* which are used lie between 6 and $1\frac{1}{2}$ inches."—G. ADAMS *on Vision*, 8vo. 1792, p. 126.

If you are a Laughing Philosopher, gentle Reader, You will not be very angry with the Author for inserting the following Anecdote: —

"In the city of Leyden, in Holland, a young woman lost her sight from a cataract; the operation of couching was successfully performed upon her Eyes, and she recovered the use of them; but it appeared that the Visual Organ (as is usual in such cases) was not completely restored to its primitive condition. Some very singular and unaccountable anomalies in her Vision presented themselves, which not a little puzzled the curious in Physiology and Optics.

"It was ascertained that her Eye was able to define a certain class of very minute objects with abundant accuracy, such as the Eye of a needle, for example, which she could thread as well as ever; but on presenting her with a Book, it was evident that she could not distinguish a single letter, but complained that she could see nothing but a heap of odd marks.

"These facts, no less strange than true, naturally excited an intense interest among the Medical Professors and Students; every one was anxious to distinguish himself by

served in the Introduction to this work — *No General Rule has more Exceptions.*

" No regular estimate can ever be established as an absolute criterion, either of the want of, or for the change of Spectacle Glasses; because, the failure or the strength

affording a satisfactory elucidation of these inexplicable phenomena.

" A hundred theories were framed — every one more ingenious than the other. The Professors VON KRACBRANER, and PUZZLEDORF, favoured their pupils with most excellent lectures on the subject, with which they were greatly edified. However, none of the disputants succeeded in establishing a Theory which met with universal approbation. Many of the vulgar still chose to think that all the said Theories might be liable to the old objection (however satisfactory and plausible they might appear), viz. — 'That they were not True.'

" Matters were in this state, when a mischievous rogue of an Irish student, who took a singular delight in ridiculing every thing learned and philosophical, contrived to insinuate himself into the confidence of a younger brother of the Patient's by a present of an extra portion of Double-gilt Gingerbread, which so entirely won the Youngster's heart, that he confessed (though with some difficulty) that to the best of his belief, his Sister " *Sarah had never learned to Read,*" but unwilling to acknowledge her ignorance, had made him and all the Family — promise not to tell."

of the Sight, varies so considerably with different people: — several youths under 20 years of Age, have applied to me, who could not see either to read or write, without very strong Magnifiers of 6 or 8 inches focus — while I have met with other persons who have arrived at 80, able to read a small print without any."

"That celebrated Preacher, the REV. MR. ROMAINE, Rector of *St. Ann's Blackfriars*, who died in the Year 1795, having attained the age of 81, could read the small print in a pocket Bible, unassisted by Glasses*, even to the last. He never wore Spectacles, nor wanted any."

"I knew a Gentleman who took the assistance of Glasses at about 40 years of Age; these after some time he exchanged for older ones; and although he lived to be 84, they were never afterwards altered, and his sight continued sound and healthy. Knowing this circumstance, I had the curiosity to measure the focus of the Glasses, and found it was 14 inches, which he had been using quite satisfactorily for upwards of 40 years."

"Another Gentleman, now living, with

whom I am well acquainted, did not take to the use of Spectacles until he was 55 years of Age: since that period, his Glasses have been twice or three times changed; and although he is now but little short of 87, yet the Glasses which he generally uses, and which he can see the best with, are 16 inches focus."

For these last Remarks I am indebted to MR. SAMUEL PIERCE.

The time that the First Glasses of 36 *inches focus will sufficiently assist the Sight* — depends on the peculiar nature of the Eyes — on the wear they have previously had — on their subsequent exertions — and on the Constitution and general Health of the Individual.

Persons of a strong Constitution, who make more use of their Legs and Arms, than they do of their Eyes, seldom want Spectacles so soon, — or want to change them so soon, as the Studious and those Artists who are much employed in fine works, which require not only the most earnest exertions of the Eyes,

but also the application of a powerful Magnifier.

As a general Rule, the first Spectacles will last You for reading by Daylight, during your first apprenticeship to Old Age — *i. e.* about 7 Years.

CHAPTER VIII.

WHEN TO CHANGE THE FIRST SPECTACLES, FOR STRONGER MAGNIFIERS.

When You find a recurrence of the Symptoms which first prevailed upon You to wear Spectacles — and begin to see but little or no better with the first Glasses, than you then did with your naked Eye — your Eyes require *The Second Sight* of 30 inches focus. — But, I most earnestly entreat my friend the Reader, to be content with as little assistance as will enable him to read a Newspaper comfortably by Candle-light,* at about the same distance he did before his Sight was impaired — from 8

* See Reading Candlestick or Lamp, in the Table of Contents.

to 10 inches, is the mean distance at which common Eyes, in their mean state, see most distinctly.

When you find that *the First Sight* of 36 Inches focus, is hardly sufficient help to read by Candle-light — to examine any very minute object — *i. e.* to make Pens, &c., You may get *the Second Sight*, of 30 Inches focus. — But pray — only use them, for purposes for which you find *the First Sight* is quite insufficient.

The following Advice of Mr. George Adams, the Optician, is excellent: —

" Those who are careful in following a regular gradation in the change of their Glasses, may preserve their Eyes to the latest period of Old Age, and even then be able to enjoy the comforts and pleasures which arise from distinct vision. Do not therefore precipitate these changes, lest you should absorb too soon the resources of Art, and not be able to find Spectacles of sufficient power."

G. A. *on Vision*, 8vo. 1789, p. 108.

Many persons have irreparably injured their Eyes, and indeed have worn out their Sight prematurely — by beginning with *Spectacles of*

too Short focus, *i. e.* which magnify too much, or as the common expression is, are *too Old.*

Nature soon bends to Custom. Eyes which have been excessively stimulated by too deep Magnifiers, seldom or never recover their elasticity.

CHAPTER IX.

MY GRANDMOTHER'S SPECTACLES.

How often a story like the following, is told to Opticians* by persons coming to change, what They call their First Spectacles.

When their Optical friend expresses his surprise to find them choose very old Glasses of 12 or 10 inches focus, instead of *the Second Sight* of 30 inches focus,

* There are very few Opticians but what must have seen instances of Persons who by habituating their Eyes to Glasses of too short a focus, *i. e.* of too great a magnifying power, have so injured those tender organs as to deprive them of future assistance from Glasses.

This not unfrequently happens to Bargain-hunters—*who buy their Spectacles of — Hawkers and Pedlars — Toy-shops, Dealers in Marine Stores, &c.*

They say, "Why, when I thought that I began to want Glasses,—I recollected—that there was a pair of nice *New Spectacles* in my Grandmother's old Bureau,—and I had often heard the old Gentlewoman say, when she was past her 70th Year—that she could still see to read Charmingly with her *New Spectacles!*—and so I thought, that I could not do better than use those Glasses whose sight-restoring power I had been Eye-witness of.—I naturally thought, that they must surely be capital Spectacles which enabled so Old a Person to see so well: and when I put them on, I was not disappointed—for they made every thing appear very big indeed, and I could read the smallest print very nicely indeed—better than I had been able to do with my naked Eye for a long time past."

I must now give you a hint, gentle Reader,—however improper such mighty Magnifiers may be for your Visual Organs—preserve them with all care—the occasional use of them will greatly contribute to preserve that Grand Organ your Stomach. No "*Grand Gourmand*" who has any pretensions to prudence,

should venture to attend a TURTLE-FEAST* without such Sentinels on his Nose — they are absolutely as indispensable a part of the paraphernalia of the Banquet — as a Plate or a Spoon!

The Eye is a mighty and merciless enemy to *the Stomach* — alas! as the Proverb says, "it is bigger than the Belly." Now even supposing your Eye to be as big again, — with these powerful Spectacles, your Eyes may be filled with delight, and your Stomach also: for the former, will imagine that while you

* "Nothing is more difficult of digestion, or oftener requires the aid of *Peristaltic Persuaders*, than the glutinous *Calipash*, which is considered the "*Bonne Bouche*" of this surfeiting Farrago."

The usual allowance at a TURTLE-FEAST is 6 Pounds live weight per head:—

"At the Spanish Dinner, at the City of London Tavern, in August 1808, — 400 Guests attended, and 2500 pounds of Turtle were consumed."—See BELL's *Weekly Messenger* for August 7, 1808.

Epicure QUIN used to say that it was "not safe to sit down to a Turtle Feast at one of the City Halls, without *A Basket-hilted Knife and Fork.*" — From page 251 of the 5th Edition of THE COOK'S ORACLE, 12mo. 1823.

have been leisurely sipping a small Soup-plateful, you have been swallowing an immense Tureenful:—What a beautiful delusion! at once, equally delightful to your Stomach, your Eye, and your Tongue — equally magnifying the pleasure of those two most troublesome of the Senses — the Sight and the Taste — which are ever the most irrationally importunate in their demands, and the most difficult to be satisfied!

Whenever your Tongue cries out for more dainties, than your Stomach has previously plainly told you is agreeable to it — to settle all the difference of their demands to their mutual satisfaction, you have nothing to do, but to — put on your Spectacles, and you may set to at *Calipash* and *Calipee* with impunity; for, they will make "A LITTLE LARK" look like

"A LARGE FOWL,"

and "A PENNY ROLL" as big as

"A QUARTERN LOAF!!!"

Some Philosophers have said, that *Pain* is only imaginary, — we may as justly believe the same of *Hunger;* and if a Gentleman who eats only an Ounce of Mutton, imagines, by the aid of these magnifiers, that he has eaten

a Pound — his Hunger, ought, to be as fully satisfied.

MEM. The Addition to your Optician's Bill — will soon be overpaid by the subtraction from your Butcher's and Baker's.

CHAPTER X.

HINTS TO PERSONS CHOOSING SPECTACLES TO READ WITH.

A PART of the paraphernalia of an Optician's counter, is a Book* of rather a small print, (about the size of the Note at the foot of this Page) — which is presented to those who come to choose Spectacles — and such Glasses are very properly recommended, as will enable the person to read it — at the same distance, and with the same ease, that he could before his Eyes were impaired, *i. e.* through which the Letters appear perfectly distinct, and of their natural size.

The first thing to attend to, is to look at a Book with each Eye alternately (shutting the other), and carefully ascertain, if you see equally

* The Author will be sadly disappointed if in future this Work is not the Volume chosen for that purpose.

well, with both Eyes, with the same Glass, at exactly the same distance. Persons are quite unconscious of the frequent inequality in the focus of the two Eyes till they thus try them separately; when they often find that a Glass which will do very well for one Eye — is of little or no use to the other, which to be rendered effective must have a Glass of a different focus.

With Glasses not Convex enough, or, according to the common expression, which are *too Young,* You will not see clearly, unless the Book is placed so far from your Eyes, that the Letters cannot be seen distinctly.

With Glasses too Convex — or too Old — You will be obliged to bring the Book nearer to your Eyes than you did when your Sight was good — and the Letters will appear larger, than they really are. Spectacles which magnify too much, will strain the Eyes even more than those which do not magnify enough — and instead of retarding, will accelerate the defect which age brings on.

" When persons apply to an Optician for Spectacles to read or work with; they should clearly understand, that the Objects for which such Spectacles are solely calculated, are not

placed more than 12 or 14 Inches from their Eyes — *i. e.* whether Reading, Writing, Sewing, &c. for there seems to be a natural impulse in most persons, that after a printed Book has been handed them for trial to read, they will presently look off — to some object on the other side of the Room, or across the Street, and say, 'Why now I can see well enough to Read with these Glasses — but I cannot discern what that word is over yonder Door;' and the Optician has oftentimes no little trouble to convince them, that such Spectacles are not intended to show objects at a distance — to see which, their Sight is as strong as ever; and in fact, that they can see distant objects best with their naked Eye."

"A person in business, with whom I was acquainted, began to want the common Optical assistance, especially for Writing, when about 40 years of Age — the Glasses he first used were of 30 Inches focus, but he soon found them useful to look at the labels on the parcels of Muslin arranged on the shelves around his Shop: after a while, he found it easy and convenient to keep them on during the Day, to

serve his Customers, or occasionally to look along the Street for a passing friend. Another pair of deeper focus, was a repeated necessary consequence, for the mechanism of his Eyes naturally formed themselves to the power of the Convex Glasses, and his Eyes still growing older — and strained by too strong excitement, at last would not perform their office distinctly, unless assisted by Spectacles of 11 Inches focus — so that he became literally half-blind in the course of about 10 Years.

"This, is not a very singular, — but a very common case, — and one of the most frequent causes of irreparable injury to the Eyes, and is one of the first cautions to be given to those who are choosing *Convex Spectacles*.

"From not being aware of this, I have known several Painters and other Artists, who have, in their natural anxiety to see as well as possible, irremediably injured their Sight — so that when they became 60 or 70 years of age, they were obliged to use Two half glasses of different foci fixed in the rings of a Spectacle frame—the upper half to help them to observe a distant picture or sketch, &c. and the lower half to transmit it to canvas."—Mr. S. Pierce.

With such divided Glasses, it requires considerable attention to raise or depress the Eyes sufficiently, so as only to look through one half,—and that the rays from the other half, may not confuse the Eye and distress its adjustment — which would be extremely perplexing and detrimental to the Eyes, to which it would be as bothering, as it would be to the Ears to have two Barrel Organs at the same moment, — One playing "*Sally in our Ally*,"— and the Other "*Ally Croaker*."

There have been several other plans for obtaining the convenience of Two pairs of Spectacles in One frame — by having the glasses to turn up on the side, &c. but all such contrivances are at the expense of the Eye — the Magnifying power of Spectacles has also been made to vary from 36 to 12 Inches focus, by having two Eye-glasses, of 72 inches focus, one before the other, and separating them; but the vision cannot be so good as with the simple single Eye-glass — and those who value their Eyes — will use no other. I think the most convenient plan, and also the least injurious to the Eyes, would be to have a pair of Spectacles glassed with Glasses of the focus

required to see the distant object or sketch, &c. and other Glasses in a frame attached to the Spectacle frame, and moving on hinges — which, when brought down before the Glasses fixed in the Spectacle frame — might make combined the focus required for painting the Picture, and which, when it was requisite to refer to the Object or Sketch, might be turned up on the Forehead, quite out of the way.

"The late President of the Royal Academy — BENJAMIN WEST, ESQ. was in the habit of using *Divided Glasses* for many years; the upper half was of 30 inches focus, and the lower of 12. But for some time before his death, which happened when he was about 90 years of age, he had the upper half of 30 inches focus, and the under half of only 8 inches focus." The Glasses were round and an inch and a half in diameter.

The above account of Mr. West's Spectacles is another of the contributions of Mr. S. Pierce, who made the Spectacles.

By trying a variety* of Glasses at an Opti-

* Though in the choice of Spectacles, every one must finally determine for himself, which are the Glasses

cian's, the Sight soon becomes confused and tired, and for the moment quite unfit to appreciate with proper accuracy, what Glasses are exactly the best for it.

I advise persons who have never worn Spectacles — or are uncertain what Glasses will suit their Eyes best, to borrow One of *the Sets of Glasses*, which consist of Spectacles, of regular gradations of power, set in a frame — the first Set of Convexes usually contains the first Seven Glasses mentioned in the Table at page 33 — or, if these cannot be had — choose at the Optician's, those Spectacles which they

through which he obtains the most distinct Vision; — yet some confidence should be placed in the judgment of the Artist of whom they are purchased, and some attention paid to his directions.

"By trying many Spectacles the Eye is fatigued, as the Pupil varies in size with every different Glass, and the Eye endeavours to accommodate itself to every change that is produced. Hence the purchaser often fixes upon a pair of Spectacles not the best adapted to his sight, but those which seem to relieve him most, while his Eyes are in a forced and unnatural state; and consequently, when he gets home, and they are returned to their natural state, he finds what he had chosen, fatiguing and injurious to the sight." — Mr. G. Adams *on Vision*, 8vo. 1789, p. 96.

think they can see best with, and take home with them also, Two other pairs, one a degree more, the other a degree less Convex, or Concave, as they happen to be either Long, or Short-Sighted: — they should try these repeatedly for whatever purpose they wish to employ them: — should take care, that the Glasses they try are all perfectly clean — and that they hold them as close and parallel to the Eye as Spectacles are placed.

They will probably find, if they try them by *Candlelight,* especially with a very small print or fine work — that one degree of magnifying power more than they require by *Daylight,* will show very small objects most distinctly — but I protest against such indulgence at first — when the Sight is much impaired by Age — a pair of Glasses for use by Day, and another for Night, are advisable comforts for the Eyes.

The best plan for the Preservation of the Eyes, — is not to employ them in any work at Night that gives them any trouble: — let all Business which requires intense attention, such as mending Pens, &c. be done by "the better Day."

At any Age,—the less the Eyes are actively employed at Night, the better—after the labours of the Day, the Eye participates in that languor which every other part of the System suffers, and the tone of the Visual Organ is comparatively feeble—therefore avoid as much as possible, reading a small print, or any business which requires the earnest exertion of the Eyes—and always use a shaded light.

The moment that your Eyes, by beginning to feel hot and fatigued, give you a hint, that they have done as much work for you as is agreeable to them—leave off exerting them.

*Forcing the Eyes to Work at Night,** even for a few moments after they are tired,—will often, put them out of humour for the whole of the following Day, and is of all Eye-spoiling Acts the most mischievous;—want of Mercy in this respect, *has prematurely ruined the Eyes of Thousands!*

Several Young Ladies, of only about 25

* "The frivolous attention of a quarter of an hour of an Evening, has cost many, the comfortable and perfect use of their Eyes for many years:—the mischief is effected imperceptibly—the consequences are irreparable."—Mr. G. Adams *on Vision*, 8vo. 1789, p. 98.

years of Age, have complained to me that they could not work without Spectacles of 30 Inches focus — who I found, on inquiry, very justly attributed this premature failure of their Sight to having been obliged frequently to sit up at Needle-work half the Night during the time they were with Dress-makers.

Those who have any regard for the Eyes of their Children — will make it part of the agreement, when they article them to any Business requiring the earnest exertion of their Eyes, that they shall never be required, on any pretence, to use them at latest after *Nine* o'clock at Night.

A friend of the Author, who has passed his 60th year, and has found it necessary to use Spectacles ever since he attained the age at which they are usually wanted; whose occupations have occasioned his Eyes to be constantly employed on small objects in print, writing, and drawing, by Candlelight as well as in the Day, by careful management, is still enabled to see with Spectacles of the

first power, or 36 inches focal length, for common purposes;—*i. e.* for reading moderately sized prints, and writing in Day-light.

His practice has been, from the period of first using Spectacles, never to employ a higher power than was immediately and absolutely wanted for the particular occasion,—for which purpose he constantly carries with him Two pair of Spectacles; one pair of 36 inches, and another pair of 24 inches focal length; the two pair put on together, serving him for a magnifying power of 12 inches focal length for extraordinary purposes.

The Two pair of Spectacles are for the convenience of being carried in the pocket: at Home, in his study, he has by him all the gradations of 36, 30, 24, 18, and 12 inches focal length, to be used as required.

He observes, that immediately after using Spectacles of a high magnifying power, the Sight does not easily accommodate itself to a lower power; and in such cases, it is necessary to give the Eyes a little time to rest and recover themselves.

This strain of the Eye, and occasion for

Spectacles of a high magnifying power, is particularly found in *Mending Pens*;* when the inconvenience of the Eye not readily restoring itself to the capability of seeing with the ordinary Spectacles is strongly evinced: to avoid the distressing inconvenience, he has a sufficient number of Pens,† to prevent the necessity of mending any of them until he has finished writing. — This method of using the higher powers when the lower powers will not be soon after wanted, is always a provident procedure.

There is a convenience in Spectacles of a small power, while they can be used. No object can be distinctly seen through Spectacles which magnify very much, beyond their focal length; and in using the high magnifying power of 12 inches focal length, prints and writings to be re-

* Those who find the *Mending of Pens* rather a difficult Job; I recommend the occasional use of A STEEL PEN — especially when they wish to write very small and neatly.

† *Mending Pens, and all operations requiring the Sight to be in its best condition,* should be attended to early in the Day while the Nerves are brisk, and before the Eyes are fatigued: provided the higher magnifying powers are not wanted for this purpose.

ferred to must be placed within that distance of the eye; but with the smaller power of 36 inches focal length such objects may be placed to that greater distance from the Eye for being referred to.*

Therefore the smaller the power, provided it be sufficient, the more pleasant and convenient will be the Spectacles.

By placing upright against a wall, a paper with moderately large printed letters, such as usually occur in the title-pages of Octavo books, he finds the greatest distance he can distinctly see the letters with a good light, to be the Focal length of the Spectacles. For the usual method of measuring *the Focal length of Spectacles* — See Chapter XV.

If any doubt should be entertained of the Two Glasses not being of the same focus, he tries each Glass separately with the same Eye, and the difference is immediately discovered.

Besides the alteration in the convexity of the Eye and the muscular power of contraction

* This supposes a good light, and the object not very minute: but such as could be distinguished at the same distance by the best eyes without glasses.

and dilatation, Age reduces the vividness of the illumination on the Retina; in consequence of which, although objects may be sufficiently magnified by Spectacles, yet they may be scarcely visible when the light is not very strong: but, on the other hand, a too powerful Light is injurious to the Eye. The Light should therefore be economized for the benefit of the Eye. See Chapter XIII.

The Artificial Light from Candles is rarely too strong; but "the Blaze of Day" is often too intense on white paper, and should be moderated by placing the paper so as to reduce the reflection of the rays of light upon the eye: have enough Light, but no more than is sufficient.

CHAPTER XI.

HINTS TO PERSONS BEGINNING TO WEAR SPECTACLES,

AND OF READING LAMPS AND CANDLESTICKS.

When persons first put on Spectacles, if they have chosen them ever so wisely—still, they frequently complain that their Eyes feel fatigued,—and sometimes even ache, after they

have worn them some time, especially by Candlelight. There is no wonder in this—it would only be wonderful if they did not.

It usually happens, that for some months previous to Persons wearing Spectacles, their Sight has either been strained and weakened by their trying to see what Nature had decreed that they should not,—or, their Eyes have been Idle, and unaccustomed to be used much, especially by Candlelight.

The cause of the Complaint people so often make, that their Eyes very soon tire if they use them at Night, is not, as they seem to suppose, entirely from the inferiority of Artificial Light.

Mr. ARGAND's invention gave us all that we wanted as far as *Quantity* of Light—and Mr. DEVILLE informs me that the Gas light from the Cocoa Nut Oil has the *Quality* of Daylight; and that with it, the difference of the colour of Flowers of Sulphur, and that of Wheat Flour, may be easily distinguished, which it is difficult, if not impossible, to see with any other Artificial Light.*

* "The greatest part of Objects, in Candlelight, are always tinged with a Yellow Red, though we are not sensible thereof; because all the objects in view are

There are some perfectly authenticated instances of persons possessing the faculty of Sight as to the perception of *Form*—who had no sense of *Colours*—others who could not distinguish their difference by Candlelight—and one I have met with who by Daylight cannot tell Red from Green—but recovers the power of discerning them correctly by Candlelight. The latter is a very singular anomaly of Vision.

THE

CUMUMBRA & SEMIUMBRA LAMPS,

Made at DEVILLE'S *Manufactory, near Exeter 'Change, Strand.*

THE shade of this Lamp is so contrived that it completely prevents any of its rays coming

changed in the same proportion. But if in the day-time you place Candles in a darkened chamber that every thing therein may be well illuminated, and then retire to another place illuminated with the Sun's light—the Objects illuminated with Candlelight, when viewed through the door of the room, will appear tinged with a yellow red, when compared with those that are seen at the same time illustrated with Daylight."—Dr. PORTERFIELD *on the Eye,* 8vo. 1759, Vol. I. p. 127.

to the Eyes—the pupil of which is therefore regulated solely by the object under examination. Every part of the Frame, &c. is coloured a dead black.

The faults of all the other Reading Lamps which I have seen, are, that the shade does not come either high or low enough to completely shade the light — and at the top is partly composed of fretwork which shows the light through it — and the frames are frequently painted with a light colour; and highly varnished.

To this Lamp may also be fixed a Half shade, which will screen the Light from the person reading, and at the same time light the Room — which in some cases is a very desirable contrivance.

It is so simple in its construction, that it is not liable to get out of order, and there is very little more trouble in trimming it for Seven hours, — than there is in Once snuffing a Candle.

It is not only cheap in the purchase, but in use, for I think it affords more light than Two Candles at the cost of One. The Oil reservoir holds three-fourths of half a pint of Oil, which at the present price of the very best Lamp Oil,

(5*s*. 6*d*. per Gallon,) costs 3 pence, which divided by 12, (the number of hours it will burn,) gives the expense of this Light, *i. e.* A Farthing per Hour.

The Light of the *Cumumbra* is so good; that Persons whose Sight is beginning to fail, and who cannot read by Candlelight without Spectacles of 36 inches focus, with this Lamp read as well as they can by Daylight; and so it deserves all the praise which the pickpocket gave to the Gas light—"It is as bad as Daylight!"—*i. e.* for Opticians; for by the help of this Lamp persons may read a year or two longer than they would be able to do without—and always, with Glasses of the same magnifying power which they use by Day.

The effect of a strong Light* I have seen, evidenced by the fact—that Persons who have many years used Spectacles, when the Sun shines on their Book, can see without.

I believe, that *the main Reason why the Sight*

* "A person who has been obliged for some years to use Spectacles in reading, will, in the Sunshine, be able to read very easily without them."—Dr. PORTERFIELD *on the Eye*, 8vo. 1759, Vol. I. p. 162.

is not so sharp at Night as it is in the Morning, is, that the Eyes are tired, by having been at work all Day.

The sensibility of the Sight is surprisingly recruited by Sleep. Dr. Porterfield, in p. 38 of Vol. II. of his Essay on the Eye, observes, " the Pupil is very large upon our first awaking."

I have for many years been accustomed to sleep with a light in the Room — and if at any time it has gone out, I have generally awoke just time enough before to previously light a Candle: and have often wondered, that the diminution of so faint a light had such a strong effect on my Eye, as to awaken me out of a sound Sleep.

I read the above to Mr. Bundy the Engineer, and he said — " The very same thing happens to me — I always awake just before my Night Lamp goes quite out."

The best Light for burning all night is the *Semiumbra* * Chamber Lamp, this may be set with perfect security on a Table by the Bedside within reach, and by turning it half round, you

* Made by Deville, near Exeter 'Change, Strand.

may in a moment, have either Light or Shade — a frame may be made to carry it over a *Bainmarie* Saucepan, like the Nursing Lamps for keeping children's food warm, which will keep half a pint of Tea or Broth warm all Night. This will be *a great Comfort to Invalids* — especially to those afflicted with Nightmare, for which a draught of hot water will give more immediate, and more permanent relief, than any remedy I have tried.

See the Author's own Case in pages 206 to 214 of "THE ART OF INVIGORATING LIFE," 4th Edit. 12mo. 1822. Published by HURST and Co. No. 90, Cheapside.

The strongest objection to Candlelight is, that the degree of Light given by *A Candle*, and its distance from the Eye, is varying every moment; — *A Lamp* has not this disadvantage: by merely bringing it nearer to, or removing it farther from the object under examination, its Light may be either increased or diminished, and may be adjusted to almost any degree; and it will continue the same for several hours.

Those who cannot recollect having played so much with a new Plaything, " and fancied

toil a Pleasure," till the pleasure became a Toil,—must have a much worse Memory—than I hope you have, gentle Reader!

I dare say, that "many a time and oft," this has happened to all my Readers,—with much less bewitching Playthings than a pair of Spectacles must at first be to a person who after Old Time has for several months interdicted him from the amusement of Reading, &c. by this inestimable invention, finds the full enjoyment of his precious Sight—suddenly and perfectly restored!

From one of the causes above mentioned, when persons first put on Spectacles, their Eyes are generally in a state of weakness, if not of disease:—moreover, at the Age which people usually find their Eyes refuse to be employed on actual service without optical aid be allowed to them,—(which, as I have before said, happens soon after the 40th year), the Visual organs occasionally get out of tune, and participate in that general deterioration of action which every part of our Machinery then begins to suffer.

Very soon after we pass the Meridian of Life, every Sense becomes duller and weaker,

but no one fails so remarkably, as the fine faculty of Sight; — and although Spectacles revive the Visual powers; — they cannot restore to them the untiring energy they possessed in early life.

Elderly persons can no more play with their Eyes, either so well, or so long, as they did when they were Young — than they can with their Legs and Arms, &c.! — to expect that they can, is about as ridiculous, as to suppose that Infirmity on Crutches, has any chance of rivalling the Champion of Pedestrians in walking 1000 Miles in 1000 Hours.

Those who consider these things, will soon cease to be very much surprised, that their Eyes tire sooner at 60 than they did at 16 — just in proportion, as all their other faculties become sooner fatigued.

The effective state of the Eyes, like that of every other part of the Human frame, depends upon that of the Circulation, — which depends upon the condition of the Stomach, and the more or less stimulating Quality, and the Quantity of the material that it is supplied with.

Several Studious Persons have told me, that their Eyes are never in good order till they

have had their Breakfast—that then, they feel as if they were all Head for three or four hours—and then, have as irresistible an inclination for Bodily Exercise, as they had previously for Intellectual occupation.

Over-exercise * of the Eyes, will occasion a temporary exhaustion of them, in like manner as over-exercise of the Legs will disable a person from walking with his wonted energy—till Rest restores vigour to him.

I have often heard people complain of their Eyes being out of humour for several days, after being exposed to the glare of the lamps at the Theatre, &c.—from being fatigued by sitting up after their accustomed Hour,—or from other causes which distressed their Nervous System.

When I was 45 years old, I was employed

* "The instances of *Weakness of Sight* which occurred in the early part of my Ophthalmic practice, were marked by great constitutional delicacy, and the individuals had most clearly brought on the Disease, either by excessive attention to fine dazzling work, or by inordinate indulgence in literary pursuits protracted frequently to late hours."—Mr. J. STEVENSON *on Weakness of Sight*, 8vo, 1819. p. 57.

some hours during several Nights, in looking intently through Reflecting and Achromatic Telescopes, endeavouring to ascertain the comparative Illuminating powers of various Instruments, — and the effect of variously constructed Magnifiers, for shewing *the Division in the Ring of Saturn*, and for separating some of the faintest and closest *Double Stars* — my Eye became so extremely tired that the sharpness of my Sight was so sensibly impaired — that for two or three days after I hardly knew any face that was 20 feet from me, — and became so much alarmed, that I mentioned it to an eminent Optician, who said, "Don't be uneasy, the same thing has happened more than once to myself; your Eye has been over-worked — give it a few days' Rest and I dare say it will soon come round again." — His prediction speedily proved true.

One of the tests to which I put my Eye, and my 5 feet Achromatic, which has a double object glass of $3\frac{8}{10}$ aperture, — was, to ascertain with how Low, and how High a power I could see the small Star near *the Pole Star*: — it was a decidedly detached point of light with a single eye-glass, which gave the Telescope a

power of only 28, i. e. with the 2d E. G. of a compound Astronomical Eye-piece which magnifies = 44 times — and it was visible with 20 intermediate Eye-tubes, the highest of which magnifies 1386 times and is a single Convex lens of the 22d of an inch focus. — The Object Glass being of

63 Inches focus,
gave, multiplied by 22

126
126

the Magnifying Power 1386.

This Instrument is one of the *chef-d'œuvres* of the late Mr. Peter Dollond — who thus speaks of it to the Gentleman he sold it to, Mr. G. Hodgson, F.R.S., (and of whom I purchased it,) in his Letter, which is now before me, dated Nov. 11, 1803 : — "It has been made 10 years, and I can say that it is one of the best I ever made, and such as I cannot expect to be able to equal."

This 5 feet Telescope literally deserves to be called *Achromatic*, for it shews the disk of the Moon and of Jupiter as white and as free from colour as a Reflector ; — to its perfect Achro-

maticism I attribute in great measure its power of very distinctly shewing *the division in the Ring of Saturn.*

The visibility of the dark line, which proves the Ring to be double, depends not only upon the distinctness of the image formed by a Telescope, — but on the power it has to shew a white object quite white, and a black one, black.

When *Saturn* is near the meridian, the division in its Ring is most plainly visible: but it may generally be observed Two, and in very fine Nights, Three hours, before it comes to the Meridian.

Those who wish to see this in London, are advised that they will not discern the division in the Ring half so well before — as after 10 o'Clock.

In this " Elysium of Bricks and Mortar" we are so surrounded by " Groves of Chimneys," that until the majority, of the Great Fires of the great Manufactories are out — the obfuscated atmosphere of this monstrous metropolis defies all the penetrating power that the immortal Herschell himself could bring against it.

Objects which require all the powers of the Eye to be fresh, and in fine condition, should

not be examined when that Organ is tired with having been at work all Day.

If a Planet comes to the Meridian at Midnight, at 9 or 10 o'Clock lie down in a quiet darkened room, and rest your Eye by getting a nap previously. A little Horizontal Refreshment, you will find a proper and renovating preparative for such Contemplation; — half-an-hour's *Siesta* will restore the tone of your Visual Organs, and sharpen your Sight prodigiously.—

"Experto Crede."

I also saw the small Star near the Polar Star with my *Beauclerc* Telescope, which has a triple Object glass of 46 inches focus, with a Lens of the 22d of an inch focus, which gave this Glass a power of 1012 times.

This singularly perfect Telescope, which shews Stars as stark neat as ever Nature permitted them to be seen; — I purchased at the sale of *Mr. Aubert's* Instruments, when they were sold at his Observatory, at Highbury Place, by Mr. S. Sotheby, July 24th, 1806: — it was originally fitted up for the *Honourable Topham Beauclerc*, and *Mr. Ramsden's* name is engraven on the Eye-end of the Telescope — but *Mr. Peter*

Dollond informed me that he made the Object Glass — and smiling at the time he gave me this information, said, "Yes, that Object Glass is one of the things which is to make me immortal," and I then gave him permission to engrave his title thereto on the tube of the Telescope.

To have produced such a perfect Instrument is so honourable to the talent of the artist, that, to avoid all appearance of prejudice to either of these eminent men, I have called it by the name of the person it was made for, *Beauclerc.*

In the Second Part of "THE ECONOMY OF THE EYES," which is now preparing for the Press,

"Paulo majora canamus"—

the Illuminating and Magnifying Powers of NEWTONIAN, — GREGORIAN, — CASSEGRAINIAN,— HERSCHELIAN Reflectors,— and GALILEAN,—HUGHENIAN and ACHROMATIC Refracting TELESCOPES of various sizes, — will be explained by Experiments made with 46 Telescopes of from 3 Inches to 7 Feet focus, which I purchased for that purpose, and have cost me upwards of £1200; and which all who

have Instruments of the like dimensions, may easily verify at the expense of a few shillings.

A circumstantial account will be given of their several performances and powers, as Astronomical and Day Telescopes,—being the results of 30 years' observation.

To enable my Readers to measure the respective merits, and the relative reflective powers of *Convex*,—*Concave*—and *Plane* Small Specula—I shall lay before them, an abstract of their several pretensions as stated by preceding writers thereon;—then proceed with those Practical Observations which I have made myself, and those which I have been favoured with by several scientific Opticians, and amongst them those experienced and excellent Makers of Reflecting Telescopes, Messrs. Watson—Tulley—and Cuthbert—who have given me their Notes and Observations thereon, and the account of the Facts which they have actually ascertained in the course of their numerous experiments with Telescopes of various constructions. I have only room in this page to add, that the Opinions of these eminent Practical Opticians are perfectly unanimous, and in perfect unison

with those published by Sir I. Newton,—and that I believe, that their Evidence and Arguments are so true, and so convincing, and so plainly stated, that they will be perfectly satisfactory to the Reader, and will finally settle certain important points, which without such Illustration, seem to me, likely to remain as they are at present—

"Puzzled with Mazes, and perplexed with Errors."

I shall also give an account of the invention and advantages of the PANCRATIC EYE-TUBE, which to a 3½ Achromatic, gives in the most perfect manner every degree of Magnifying power from 100 to 400 times—which will be minutely described and explained by Engravings.

N.B. *Contributions on Optical Subjects, addressed to the Publishers of this Work, will be gratefully acknowledged.*

I have mentioned my own case of *dimness of Sight*, because, I believe many Artists, from the want of such a hint, have greatly injured their Eyes, by having been induced by similar Symptoms, prematurely to put on Spectacles: but, in such cases, "Rest is the best Remedy."

"So great is the calamity entailed upon the

makers of fine Pieces of Workmanship, such as Clocks and Watches, that many of the Workmen are almost Blind before they arrive at Old Age. I know a Jewish Woman in this City that had a peculiar way of stringing of Pearls, so as to cover their blemishes if there were any, and by that means got a deal of money; but when she came to be forty years of age, finding no manner of relief from Spectacles, she was forced to leave off the Business. I remember likewise to have heard several *Printers* complain, that they have given a considerable shock to their Eye-sight by composing small types.

"In earnest, *I do not see how we can afford any Relief to the Workmen we now treat of;* for it is not easy to persuade them to leave a beneficial and lucrative trade; and *Physic is unprovided with any Remedy that can restore the primitive Strength and Mobility of the Eyes, after the Disorder has become inveterate:* for neither Purging, nor Bleeding, nor other Medicinal Means, can take place in this Case, in regard the Patients are otherwise Well and Brisk, and their Spirits being neither clouded nor incrassated, it would be improper to punish an

innocent and sound Head with the Commotions of Medicines.

"However, I would advise such Workmen not only to use Spectacles, but to *intermit from their Work now and then,* and refresh their Eyes by Diversity of Objects. For we can't imagine How much the Mobility of the Membranes of the Eyes, and the native Fluidity of the Humours, is kept up by viewing divers Objects; some near at hand, some remote, some directly, others obliquely; and, in fine, all manner of ways: for by this Means the natural Disposition of the Eye is preserved, so that the Ball is sometimes contracted, and sometimes dilated; and the Crystalline Humour approaches more or less to the Pupilla, according as the remoteness or nearness of the Object requires. Without this Diversity of Action, the Eyes undergo the same Fate with the other parts, that, by being long detained in one position, grow stiff and unfit for Motion." — RAMMAZZINI *on the Diseases of Tradesmen*, chap. XXIX. of the Eng. Trans. 8vo. 1705, p. 219.

WATCH-MAKERS, ENGRAVERS, and those who are in the habit of using *Strong Magnifiers,* would feel their Eyes much less fatigued, if

the objects they examine were always placed at once, and kept at the proper focus: — this might be contrived very easily, by fixing the Magnifying-glass in the opening of a Spectacle frame, or on a stand, and making a mark where the object of examination is most distinct.

Nothing can be more detrimental to the organ of sight than the clumsy practice of holding a glass by squeezing the *orbicularis muscle,* — this cannot be done without distorting, and distressing, and much injuring the mechanism of the Eye.

The less the Magnifying Power of the Glass, the less the Eye will be fatigued by it, — the less distressing the position of the Body in working with it, and the larger and more uniformly distinct the field of view: and where a moderate Magnifying power is sufficient — instead of a single magnifier, I think it will be better, especially for Etching, and for examining the general Effect of Engraving, &c. to wear Spectacles of 9 inches focus — with which I think that Artists might work longer than with only one Eye.

The *Compound Magnifiers,* which are composed of two plano-convexes with their plane

sides outwards, are very pleasant — as they have a large and uniformly distinct field. — I have not met with any body who was aware this construction of Eye-glass was invented so long ago as appears by the quotation I here insert: —

" *Eustachio Divini* hath made a Microscope with two plano-convex Glasses, which are so placed as to touch one another in the middle of their convex surface — and hath this peculiar quality, that it shews the object flat and not crooked; and although it takes in much, yet magnifieth extraordinarily." — See *Phil. Trans.* for 1668, Vol. III. p. 842.

Concaves which make objects appear the size Artists wish to draw them, are very useful to *Miniature Painters*, who should have them of two or three different degrees of Concavity — so mounted on a stem that they may be used separately or altogether: thus they may see an object of 6 Feet in diameter reduced to exactly the size it is to be delineated, i. e. to any degree between 6 Inches in Diameter, and half an inch in Diameter.

The condition of our Corporeal Machinery, has great influence on that of our Eyes; — and indeed of all our Senses. — During that state

of collapse which it is just now the fashion to call "*a Bilious Attack*" — or "*a Nervous Paroxysm*" — just in proportion that we are out of Heart, — the Circulation is feeble and languid, and every sense performs its functions imperfectly. — During such prostration of the Vital powers, it is not uncommon to hear people complain of NERVOUS DEAFNESS. — It is equally common for them to be afflicted in an equal degreee with NERVOUS DIMNESS OF SIGHT.

This occasional dulness of the Ears, is oftener observed, than the dimness of the Eyes; — because the former defect is obvious to others, — the latter is confined very much to ourselves; and unless we happen to want to minutely examine some *minimum visibile*, which requires all the powers of the Sight to be in full force to be discernible, such a paroxysm of Ocular obtuseness often passes unnoticed, and is seldom strong enough to excite the attention of healthful persons, until they have passed their 40th year; who will then generally find, that it may be traced either to over-exertion of the Eyes, or to some Disorder of the Digestive Organs.

During derangements of the Restorative

Process, for which the Phrase of Fashion now is when you are Nervous or Bilious — the Eye-lids are often affected with "*Ophthalmia Tarsi*," i.e. a slight Inflammation and an increased secretion of the glands about the Eye-lids — which (in plain English) become gummed, and when the Eyes are first opened in the Morning, the Eye-lids feel stiff and the Eyes irritable.

The Eye-lids, are much oftener disordered than *The Eyes*; —perhaps three-fourths of what common people commonly call "*Bad Eyes*" are merely disease of *The Eye-lids.*

I have not space in my little Volume to descant on One of the 118 Principal Diseases of the Eye enumerated in the Work of the elaborately minute St. Yves, — but having had Ocular demonstration of the efficacy and innocence of the following OINTMENT* FOR THE EYE-LIDS — I here set it down.

> One part of Citrine Ointment,
> Three of fresh Lard — mix them thoroughly together with an Ivory knife.

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* "Whenever I am informed that the edges of the Eye-lids have a disposition, be it ever so slight, to adhere to

The Eye-lids are to be anointed with *a very little* of this Ointment immediately before going to rest.

The Eye-lids should be washed in lukewarm water as soon as you rise in the morning — and every particle adhering to them, completely, but very gently and carefully removed — which is easiest done by soaking the Eye-lids by the repeated application of a soft cloth dipped into warm water till whatever sticks to them is loosened, — then you may proceed cautiously to clean them.

each other after they have been long in contact, as during the time of sleep, and when this is accompanied with an uncomfortable sense of weight in the lids on the approach of night, in consequence whereof the patient involuntarily shuts them without being drowsy, and without any particular stimulus being applied to the Eye to give it pain, I always suspect that the secretion of the ciliary glands is in a diseased state; and in many such cases I have found the success attending the use of the *Unguentum Hydrargyri Nitrati*, recommended for the cure of this disorder, quite as effectual as in those other instances, where the excoriation and redness of the Eye-lids have been visible on the slightest inspection." — Mr. Ware's *Chirurgical Obs.* Vol. I. p. 116.

CHAPTER XII.

PRECEPTS FOR IMPROVING AND PRESERVING THE SIGHT.

The Sensibility of the organ of Sight, is in proportion to the expansion of the Pupil of the Eye,* whose mean diameter is commonly calculated at about one 10th of an inch — but varies in magnitude, from *One* to at least *Two* tenths, according to the brightness of the object which is presented to it. — See Dr. Herschell's Paper in the *Appendix*.

When the Light is too strong, or the object too bright, the Pupil closes in order to inter-

* In the 91st vol. of the Phil. Trans. page 86, in Dr. T. Young's paper on the Mechanism of the Eye — the Dr. has given in *Plate* v. *Fig.* 19, a drawing of the front view of his left Eye; "when the Pupil is contracted," the diameter of it is rather more than a tenth of an inch: and in *Fig.* 20, "The same view when the Pupil is dilated;" the latter measures almost two tenths and a half. See Copies of these Figures in *Plate* fronting the Title, Nos. 2 and 3, — in the openings of the Spectacle frame in the Frontispiece.

cept that excess of Light* which would otherwise offend the Eye : — when the Light is faint, the Pupil expands that a greater quantity of it may enter the Eye, and thus make a stronger impression upon it.

This contraction and dilation of the Pupil, you may easily discern by holding a looking-glass before your Eye at a window and turning gradually round from the window continually looking at your Eye in the looking-glass — the lowest small speculum of a Gregorian Telescope, as it magnifies a little, will shew you this still plainer : — and it may be easily and perfectly observed by attentively watching the Eye of another, during such a change of posi-

* " 95. The sensibility of the Eye, and its power to discern objects without inconvenience by different quantities of Light is vastly extensive. For instance, the disproportion in the quantities of Light cast upon the horizon by the *Sun*, and *Moon*, at equal altitudes, I find is no less than 90,000 — to 1, when the Moon is full.

" *Day-light* is to *Moon-light* as the surface of an Hemisphere whose centre is at the Eye, to the part of that surface which appears to be possessed by the enlightened part of the Moon : so that the whole Heavens covered with Moons would only make Day-light."—Dr. Smith's *Optics*, 4to. 1738, p. 29.

tion:—it is most visible in a fine full bright blue Eye.

The fact that the sensibility of the Sight* is in proportion to the diameter of the Pupil, is strongly illustrated by the following circumstance.—"What can be the reason," a very intelligent and accurately observing Artist said to me, who was sitting by the side of his window, "that when I look at that portrait opposite to me, it looks *Warm* with my left Eye, and *Cold* with my Right; i. e. with my Left Eye, which is from the window, it appears

* We can never be certain that an Object does now appear to us of the same precise Colour of which it appeared last Day or last Week: neither can our being insensible to any change ever prove to us that the Colour is the same. Not only different Persons may have different sensations of Colours, proceeding from the different dispositions of their optic nerves and Retinæ, or from the different tinctures wherewith their Eyes are tinged, but also the same person may, from the same causes, see the same Object, differently coloured at different times without being sensible of it; and experiments are not wanting, whereby it appears, that the same object was seen of different colours, according as it was viewed with the right or left Eye."—Dr. PORTERFIELD *on the Eye*, 8vo. 1759, Vol. I. p.128.

considerably brighter, than it does when I look at it with my Right Eye?"

I gave him a "*Circumspector*,"* and desired him to attentively examine the size of the Pupil of each Eye while his head remained in exactly the same position — and tell me in which Eye the Pupil was largest: his answer was, "Why, in the left certainly," *i. e.* in the Eye least exposed to the Light.

Mr. Butt, of Bath, informed me that he saw the Five first discovered *Satellites of Saturn* in an Achromatic Telescope of 44 inches focus, and 2¾ inches aperture — by placing a patch before that part of the field of the Telescope where Saturn appeared — and thereby enabling the Pupil to expand, and the Eye to adjust itself for discerning the fainter objects, the Satellites.

In observing *Double Stars*, the very minute

* The Circumspector, or "*Diagonal Eye-glass*," is a convenient assistant to a Portrait Painter, who wishes to catch a likeness unobserved, and which is perhaps the only way of obtaining the true natural expression of a Countenance — and is also an invaluable Oracle for a fair Lady to refer to, to adjust the irresistible Artillery of her Eyes and Smiles.

Star which accompanies some large Stars, (for instance the small Star near *Alpha Lyræ*) is visible when the large Star is out of the field —with a Telescope with which it is not discernible, while the larger Star is stimulating and shutting up the Pupil.

These very striking Facts, sufficiently establish the position laid down in the commencement of this Chapter — that "*cæteris paribus*" the impressions on the RETINA, are vivid, in proportion to the expansion of the *Pupil*.

These observations led me to consider how beneficial it would be to the Eyes of Painters, Engravers, and those artists whose Eyes are irritable from great exercise, if they could be so shaded, that the Pupil might be secured from being interrupted in its adjustment. For which purpose I recommend a shade made of black silk stiffened with wire, and fixed on a Spectacle frame something like the contrivance of Tubes* which are made for viewing Pictures;

* See an Account of the great advantages of Spectacles with Leathern Tubes, in the 3d vol. of the *Phil. Trans.* for the year 1668, p. 727 and 765; and for 1684 in Vol. XIV. p. 474.

such assistance to the Sight—is surely quite as advantageous to the Artist to paint with, as it is to the Amateur to examine his Picture with.

The Eye cannot adjust itself perfectly, while it is exposed to the stimulus of surrounding Objects—a defence from the intrusion of collateral rays will prevent the picture on the Retina being confused by those adventitious rays which otherwise distract it; and if only those rays are admitted into the Eye which come direct from the object under examination, it will make a much more vivid impression on the Sight, which will be sharpened and strengthened very much.

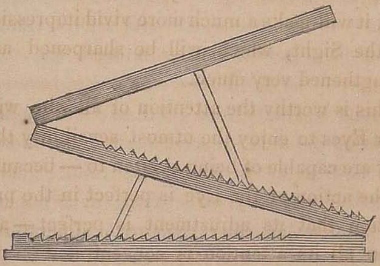
This is worthy the attention of all who wish their Eyes to enjoy the utmost sensibility that they are capable of being excited to—because,

The action of the Eye is perfect in the proportion that its adjustment is perfect—and when all its attention is concentrated on one object, the sensibility of the Sight is much increased;—moreover, you will not only see better, but Vision being rendered easier, your Eyes may be employed longer, with comparatively less fatigue.

The Pupil of the Eye is larger when shaded

by a *Broad Brimmed Hat* — such as Coachmen wear, who probably adopted this costume from its advantage in sharpening their sight.

There is no part of the Economy of the Eyes more important, than that the object they are at work upon should be placed at exactly that distance from them at which they see with the greatest ease: — this may be easily accomplished by the assistance of A DOUBLE-RISING DESK:



and hard Students will do wisely to have a High Desk at which they can occasionally stand — instead of always sitting.

Those who are much occupied in Engraving — Painting — Writing — Reading — &c. or works which require all the power of the Eye

to be exerted to the utmost — should be careful not to offend it by *too much Light*, which is quite as prejudicial as *too little Light*.

Light enough to illuminate the object, and to make it easily and perfectly visible, is all that is wanted : — on this occasion, the Old Proverb, "Enough is as good as a Feast," is quite true,— more, is not only unnecessary, but injurious, and will not only over-stimulate the Eye — and force the Pupil to shut itself up, but if continually so irritated, the Eye will soon become as much impaired by such over-stimulation, as the Stomach is by Dram-drinking.

I have observed in my visits to a numerously attended Reading Room — that the seats next the windows were generally filled by persons wearing Spectacles, who had no doubt accelerated the necessity for so doing by a habit of over-stimulating their Eyes with superabundant Light.

The proper way of defending the Eyes from too much Light, is by preventing all that is superfluous from entering the Room, by means of Blinds or Shutters — thus, you may admit only just such a degree of Light as you find most agreeable to your Eyes.

All Artists choose a Room *lighted only from one aperture* — and if possible with the steady *North* aspect ; that is the best place in the room, indeed the only proper place for Study for those who have any regard for their Eyes, where the Light falls on their work or book — coming from the side or from behind.

" It is requisite always to have an equal, well regulated Light in every employment, particularly in the Evening; the Eye may be seriously strained and injured by working, writing, or reading with either too much or too little Light: for want of a due attention to preserve the visual organ, and from using the Eyes very much during the busy part of life, a morbid sensibility is brought on, an unnatural weight of the Eye-lids, a great deficiency of distinctness, and occasionally a distressing, undulatory quivering appearance of refrangible colours on either side. To remedy this, washing the Eyes with clear cold water, and keeping them from the Light for an hour, or taking a Nap, will be found most efficacious." — S. Pierce.

If your Eyes are much employed in Reading, &c. and are extremely irritable, you may have your window glazed with Green Glass, — or a

blind of it to put up occasionally — or a rolling blind of Green Silk or Muslin — or have a plate of Green glass fixed in a Frame, which may be placed so that the Light may pass through it to your book or work. But do without all these if possible — for if they alleviate the irritation while you use them — they will render the Eyes more morbidly irritable after.

AT NIGHT — use *a Reading Candlestick or Lamp* with a shade to shield the Eye from the glare of the Light;* which is of much greater assistance to the Sight than those who have not tried it can imagine: *One* candle so shaded will enable a person to see better than *Two* without such a shade, and with *a Cumumbra Lamp* — you may see I think almost quite as well as by Day-light, — the sensibility of the Eye is preserved in such perfection.

The Optic Pupil inevitably adjusts itself to the brightest object, which therefore should

* Every thing is best seen when the light of the candle is intercepted: the bright light of the Candle not only makes the pupil contract, but by mixing itself with the images of other objects, it in some measure obliterates them, so as they cannot be so well perceived."—Dr. PORTERFIELD *on the Eye*, 8vo. 1759, Vol. II. p. 188.

be that which it is its business to attend to, — not the flame of a Candle, — but the Book you are reading.

GREEN, or any COLOURED GLASSES, veil objects with a gloomy obscurity, and can never be recommended, except to those who have to travel over a white sand, or are much exposed to any bright glare, — which cannot be otherwise moderated.

Light reflected from any white surface, is very piquant and injurious to the Sight, whether proceeding from Water — Snow, &c.

Gogglers — or black cups, glassed with plain glasses, and mounted in double-jointed frames formed to the shape of the face — are preferable to those which are fixed in Leather and Silk and tied on with riband; the latter come so close to the face that they soon become a Vapour Bath for the Eye — but the former are occasionally found very serviceable to travellers to protect their Eyes from Wind and Dust, and to shield* them from a strong Reflected Light; Blue or

* "Xenophon relates that many of his Troops were blinded by the strong reflection of the light from the Snow over which they were obliged to march.

"Dionysius the Tyrant of Sicily, among other means

Green glass may be fixed in them, but it must be of a very light Colour.

Some more nice than wise folks, among other ridiculous refinements have recommended thin *Green-Gauze* or *Crape*, instead of Green Glass — under the pretence, that while it moderates the Light, that it still admits the Air, and is, therefore, cooler to the Eyes.

All Coloured Glasses increase the labour of the Eyes, and soon bring them into such an irritable state as unfits them for all the ordinary purposes of Life: — there is scarcely an external or internal Sense, but may be brought by extreme indulgence, to such a degree of morbid delicacy and acuteness, as to render those organs which nature intended as sources of

which he took to gratify his revenge, and satiate the savage cruelty of his Temper, was accustomed to bring forth his miserable Captives from the deepest recesses of the darkest Dungeons, into white and well lighted Rooms, that he might blind them by the sudden transition from one extreme to the other.

"Actuated by principles equally barbarous, the Carthaginians cut off the Eye-lids of Regulus and then exposed him to the bright rays of the Sun — by which he was very soon blinded." — G. Adams *on Vision*, 8vo. 1789, p. 8.

gratification—the frequent sources of Disappointment and Pain.

The most proper material for Spectacle Glasses, is that which shews objects the nearest to their natural Colour.

Lastly—Whatever Glasses you use—take care to "*keep them perfectly clean:*" this is as important, as the choice of the Figure or the Colour of them.

Every time you wipe your Spectacles you scratch them a little, and "many a little makes a mickle"—therefore, when you have done using them, put them away carefully in their case, to prevent other people abusing them—as a Naughty Boy did his Grand Pa's Spectacles—who took the Glasses out—and when the old Gentleman put them on—finding that he could not see, exclaimed, "Marcy me, I've lost my Sight!"—but thinking the impediment to Vision might be the dirtiness of the Glasses—took them off to wipe them—when not feeling them, he, still more frightened, cried out, "Why what's come now, why I've lost my Feeling too!"

CHAPTER XIII.

GLASSES FOR SHORT-SIGHTED PERSONS.

I HAVE met with several persons of 30 and 40 years of Age who had no notion that they were Near-sighted, until they accidentally looked through my Spectacles at a distant object; when they exclaimed with surprise, "Bless me, how clearly I see! I never saw any Glasses before, that I could see so well with as with my naked Eye, and therefore had no idea that any Glass could improve my sight."

"I can see to read a small print, as well as any body I believe, but I have sometimes suspected that I did not see any thing across the street, or at a Theatre, quite so plainly as I have heard other people say that they did; and I suppose that the Spectacles which I tried before were not suitable to my Sight—and so I had no idea that any Glass could improve my Sight."

For such Eyes I have procured a No. 1, or No. 2, *Concave*—and they have been delighted—and said, "Well, I see now that I have never

before discerned the distinct outline of any object which has been further than a few feet from me."

Being *a Short-sighted* mortal myself, I write this Chapter with confidence, from my own experience of upwards of 31 years, and hope to be able to give some good advice to those who are unfortunately what is called *Near-sighted*— by briefly narrating "*the History of my own Case of Spectacles.*"

I was about 15 years old, when I first discovered that I could not discern distant objects so distinctly as people who have common Eyes usually do.

Mr. WARE, whose paper on Shortsightedness I had not seen till after I had written this Chapter, has remarked, (see *Appendix,*) that Young People seldom find out that they are remarkably *Short-sighted,* until about the time that I did; which is true, and perhaps for this reason, that Young Folks seldom attend to any thing in earnest before they attain to that Age —when seeing, that I could not see what persons with common Eyes frequently pointed out to me as well deserving my attention, I paid a

visit to an Optician and purchased a *Concave Eye-glass* No. 2.

After using this some little time, I accidentally looked through a *Concave* No. 3, and finding my Sight much sharper with this, than with No. 2—had my Spectacles glassed with No. 3, which appeared to afford my Eye as much assistance as it could receive.

After using No. 3 for a few Months, I chanced to look through No. 4, and again found the same increase of Sharpness, &c. which I perceived before when I had been using No. 2 and first saw through No. 3—therefore concluded that I had not yet got Glasses sufficiently Concave, and accordingly procured No. 4:—however, this soon became no more stimulus to the Optic Nerve—than its predecessors Nos. 2 and 3 had been.

I then began to think that the Sight is subject to the same laws which govern the other parts of our System; i. e. an increased Stimulus by repetition soon loses its power to produce an increased effect—therefore, I refused my Eye any further assistance than it received from Spectacles glassed with No. 2, which I have

worn for upwards of 31 years, and it is very nearly, if not quite, as sufficient help to me now, as it was when I first employed it—giving me a Sight (for objects *at a moderate* distance), as I find, by comparison, about upon a par with common Eyes:—without my Spectacles, I am quite as Short-sighted as some of my acquaintance who use Nos. 6 and 7 concave; *i. e.* we read at the same distance.

Soon after I passed my 40th year I found my Sight become rather *Shorter* as to distant objects — and rather *Longer* with respect to near objects—formerly, I usually wore Spectacles for Reading, Writing, &c.—but lately, the power of my Eye to adapt itself to various distances is so diminished, that when I read, &c. I am obliged to take off my Glasses—and objects that are more than 70 feet from me, I see better with one number deeper than that I commonly wear.—See a similar case in the *Appendix*.

The gradations of Concavity, in the Concaves of the common Spectacles which are marked *Cheap* in the windows of Sale-shops,—Toy-shops, &c.—who pretend to undersell the regular Opticians, (*Read* CHAPTER XIX, and

See the *Appendix,*) are not always worked to a certain standard, and what one person calls No. 5, another rates as No. 3, or 4, or 6, or 7.

Mr. Pierce informed me that the late Mr. Jesse Ramsden made the first No. of his *Concaves* to be equivalent to a *Convex* of 24 inches focus,—*i. e.* if a *Convex* of that focal length be united to a *Concave* No. 1—the combination will form a Plane, and objects appear through it neither larger nor smaller than they really are.

A 21 Inch Convex - - -	No. 2.
An 18 Inch - - - - -	No. 3.

and that all regular Opticians proceed in like manner.

The following is a very important fact, which the *Short-sighted* cannot be too fully sensible of:—

"I shall mention a fact with which I was made acquainted by Mr. George Adams the late Mathematical Instrument Maker, who was not only well skilled in the theory of Vision, but, from his situation as an Artist, had better opportunities than most persons of learning such matters.

"The fact is this, that he does not know a

Short-sighted Person who has had occasion to increase the depth of his Glasses, if he began to use them in the form of Spectacles; whereas he can recollect several instances, where those have been obliged to change their *Concave* Glasses repeatedly, for others of higher powers, who had been accustomed to apply them to *One Eye only*." — Dr. W. C. WELLS *on Vision*, 8vo. 1792, p. 124.

The advantage of a pair of Spectacles, over a Single Glass, is sufficiently obvious — as Objects appear brighter when seen with Both Eyes, than they do when viewed with One only. — See *Appendix*.

FOR THE CHOICE OF SPECTACLES FOR SHORT-SIGHTED PERSONS, — I have few Rules to offer — it is a defect which has no reference to Age — no stated progression that can be a foundation to guide an Optician, or lead him to recommend one Glass in preference to another — but all depends on the observation of the Short-sighted themselves — who I most earnestly advise, to be content with as Shallow Concaves as possible — i. e. to take the least Concave Glass through which they can distinctly discern the names

on the corners of the Streets, and which gives a decided outline to objects whose distance does not exceed about 40 feet, and which renders them clear, without making Vision dazzling and glaring — the Glass which does, is too deep by a Number. — See *Appendix*.

After your Eyes have been long accustomed to the assistance of *Concave Glasses*, the smallest variation in the degree of their Concavity will be extremely distressing and injurious to the Sight: — when you have found Glasses which exactly suit you — have Two or Three pairs fitted to your Spectacles, that you may be provided if a Glass gets scratched or broken.

Near-Sightedness generally continues the same during Life, and precisely the same Glass continues to afford precisely the same assistance.

After persons have used the same glass for some years — and it is broken, &c. it is often extremely difficult to make them think, that any new one suits their Sight exactly so well as the Old one which they had been in the habit of long using: therefore *Pebbles* are especially desirable for the Short-sighted.

Persons who are extremely *Short-sighted*, to prevent their stooping in writing — to read

Music, &c. &c. may wear Spectacles with very shallow Concaves, just enough to enable them to see such objects at the same distance which others do.

A Deeper Concave is wanted to see *very Distant Objects.* Dr. MASKELYNE,* the late Astronomer Royal, to look at the Constellations, found it convenient to use a Concave

* "When I look at the brighter fixed stars, at considerable elevations, through a concave glass fitted, as I am short-sighted, to shew them with most distinctness, they appear to me without scintillation, and as a small round circle of fire of a sensible magnitude. If I look at them without the concave glass, or with one not suited to my eye, they appear to cast out rays of a determinate figure not exactly the same in both eyes, somewhat like branches of trees (which doubtless arise from something in the construction of the Eye), and to scintillate a little, if the air be not very clear. To see day objects with most distinctness, I require a less concave lens by one degree than for seeing the stars best by night, the cause of which seems to be, that the bottom of the Eye being illuminated by the day objects, and thereby rendered a light ground, obscures the fainter colours blue, indigo, and violet, in the circle of dissipation, and therefore the best image of the object will be found in the focus of the bright yellow rays, and not in that of the mean refrangible ones, or the dark green, agree-

one degree deeper than he wore for common purposes in the day time—and the Author uses No. 2 in ordinary, but at Night sees many faint Stars well with No. 3, which he cannot see at all with No. 2. This is especially remarkable in the early part of the Evening when the Stars first become visible. And *at Large Theatres,* he finds one Number deeper than that which he ordinarily uses is a very advantageous indulgence to his Eye.

To give more assistance to the Sight to see a distant object, many persons hold a Concave Eye-Glass very obliquely to the Eye—in which position, a Concave No. 3 will give almost the same sharpness of outline to objects as No. 3½ when held parallel to the Eye.

For distant Objects, extremely *Short-sighted* persons should use a small Opera-glass, which having an adjustable focus, if it

able to Newton's remark, and consequently nearer the retina of a short-sighted person; but the parts of the retina surrounding the circle of dissipation of a star being in the dark, the fainter colours, blue, indigo, and violet, will have some share in forming the image, and consequently the focus will be shorter."—See *Phil. Trans.* Vol. LXXIX.

only magnifies Twice,* will be infinitely better than any single Concave, because it can be exactly adapted to various distances.

My "*Invisible Opera-Glass*," a contrivance of Mr. PIERCE and myself, is a great acquisition to Short-sighted Persons, and is an inestimable little Instrument for Artists, &c. who wish to discern the distinct outline of objects at short inaccessible distances; *i.e.* for an Architect to see the exact outline of a Building a furlong off — or to examine the pointing, &c. of the walls of upper stories, &c.

When shut up in its case, this little Glass is only 2 inches in length; — when in use, about 3 inches: — it has a single plano-convex Object-glass $\frac{6}{10}$ of an inch in diameter, and its Magnifying power is about 3 times.

* An Opera-Glass which only magnifies once, like the fashionable Grand Dandy Operas — of which the Eye-glass is as large as the Object-glass — is of no use to a *Near-sighted* person; — who, to receive the same benefit which a common Eye does, will require rather more magnifying power: — A very short-sighted person will receive very little more assistance from an Opera-glass which magnifies *Twice*, than a person with a Common Eye will from one which magnifies *Once*.

There is a very general *Vulgar Error*, that *Short-sighted* persons who use Concaves, as they get Older, become less Short-sighted: on the contrary, every Optician and *Short-sighted* person that I have consulted on this subject, have assured me, that as their Eyes become impaired by Age, to see distant objects sharp and distinct, they require rather deeper than shallower Concaves; and at a very advanced Age, sometimes complain that they cannot see to read so well as formerly, and require *Convexes* of 36 or 30 inches focus.

Mr. Pierce informs me, that Dr. Parker, the late Rector of St. James's, Piccadilly, had from his youth a short-sight, and when almost four score years of age, complained to him that he could not read so distinctly as he wished: with the help of Convexes of 36 inches focus, he was enabled to read and write with comfort to himself for several Years after. — See *Appendix*.

That a *Short-sight* is stronger and better, and more lasting than a *Common-sight* — I have always set down among the most absurd of *Vulgar Errors* — unless, to be half blind all their Life, as the Short-sighted are, is better

than to be so only during about one-third of it, and that during the latter part of Life, as common Eyes are.

This prejudice is as foolish as the silly notion some people have — that a severe fit of Gout, is a thing to give a man Joy of — which our philosophical poet, Pope, admirably illustrated when he said:—

> "So when small humours gather to a Gout,
> "The Doctor fancies he has driven them out."
>
> *Essay on Man.*

If the observations of Lord Chesterfield and Dr. Reid are true, a *Short-sighted Person without Spectacles*, is under a sad disadvantage in the common business of Life. — The following is the advice this keen observer of Human Nature gave to his Son: —

"Mind not only *What* people say, — but *How* they say it: — if you have any sagacity, you may discover more truth by your Eyes than by your Ears. People can Say what they will, but they cannot Look just as they will; and their Looks frequently discover what their Words are calculated to conceal." — See Letter 77.

Dr. Thos. Reid's observation on the Eye is — "Of the faculties called *the Five Senses,*" Sight is, without doubt, the noblest: by means thereof we can perceive the tempers and dispositions, the passions and affections of our fellow-creatures, even when most they want to conceal them: and when the Tongue is taught most artfully to lie and dissemble, the Hypocrisy appears in the countenance to a discerning Eye! and we can perceive what is straight and what is crooked in the Mind, as well as in the Body." — *Inquiry into the Human Mind,* 8vo. 1818, p. 140.

However, it is some consolation to the Short-sighted, to consider, that if the natural infirmity of their Eyes prevents their enjoying this advantage, the use of Spectacles not only enables them to see what is passing in the Eyes of others, but that they form a veil over their own, which, in a great degree, prevents any such Scrutiny; and thus — their Weakness becomes their Strength.

CHAPTER XIV.

SPECTACLE FRAMES.

I prefer a well-hammered Silver Frame with Double Joints, the Second joint of which may be turned on its pin over the First, so that they may be occasionally used with the Single joint only — they sit close and steady on the Head, and are convenient to wear under a Hat — do not press either on the Nose or on the Temples — but their pressure is general and equal, and as it may be varied, may be rendered more agreeable than any other Frame.

Spectacles with only a *Single Joint*, must press hard somewhere.

Tortoise-shell Spectacles have a gloomy heavy appearance, are no lighter than Silver ones, and are very easily and very often broken: — however, if you will have a Shell frame, let the front be all Black — variegated Shell is bad for the Eye.

The Blued Steel Frames are good looking enough when new, but soon lose their

Azure lustre, and then look very shabby: there is a prejudice in favour of a Steel frame as being very light,—and, from its elasticity, that its pressure on the Head is less than that of a Silver frame.—It may be for the first fortnight; but in the course of that time, such is the ductile nature of *a Silver frame,* which soon adapts itself exactly and comfortably to the Head, and becomes infinitely easier and pleasanter than the springy Steel; and the truth of the old saying, "as easy as an Old Shoe," is remarkably felt in "an Old Silver Spectacle Frame."

That the Frame should be Light, is the only point which either the Makers or the Wearers of it seem to pay any attention to—and to Lightness, every other property of it is willingly, but ridiculously sacrificed.

The actual difference in Weight between a Silver Front of that proper degree of strength which I have recommended, and one of the silly flimsy fronts which are commonly so much admired, does not exceed *Four Pennyweights.*

Let the Frame be large enough not to press

on the Head, *or Head-aches,* &c., &c. will be the inevitable consequence.

The Length of the Bridge, *i. e.* the distance between the Glasses, must be regulated by the distance between the Eyes, and *the Centres of the Glasses* must come exactly before *the Centres of the Eyes;* — according to the coincidence of which, Vision will be perfect or imperfect.

The mean Distance between the centres of the Pupils of the Eyes of People in general, is about Two Inches and a Half.

The following are the usual proportions of Spectacle frames.

The Length of *the Bridge,* from an Inch to an Inch and $\frac{3}{10}$ths.

Of *the Openings* which hold the Glasses, if they are Oval, the longest diameter should not be less than an Inch and $\frac{1}{10}$th, the Shortest about $\frac{9}{10}$ths.

The length of *the Common Knuckle* is about $\frac{4}{10}$ths of an Inch: — in some peculiarly formed Faces, this must be wider, and in others narrower.

The Length of *the Knub Knuckle* (which is

decidedly the most elegant) is only $\frac{2}{10}$ths of an Inch.

THE WIDTH OF A COMMON FRAME.

	Inches.	Tenths.
Bridge	1	1
Openings for the Glasses	2	4
Rims of ditto		2
Common Knuckles . .		8
	4	5

See Figure in the Plate fronting the Title.

To assist the Optician *to ascertain exactly what ought to be the breadth of the Bridge,*—I recommend him to have a Trial Frame, with an adjusting Bridge which will separate half an Inch—and such separating part graduated 1. 2. 3. 4. 5. for each $\frac{1}{10}$th of an Inch — put these on, and adjust them till *the centres of the Glasses* come exactly before *the centres of the Eyes.*

If his Frames are numbered 1.—2.—3.—4.—5. according to the width of the Bridge—the Eyes of his Customers may be immediately suited to a nicety.

The Form of the Bridge must be regulated by the Form of the Nose which it is to cross.

The closer the Glasses are brought to the Eye the better, provided they do not come so close as to be touched by the Eye-lashes — if they do, the Glasses will be continually dimmed by the moisture from the Eye-lashes; * and what is worse, the Eyelids will become irritated and inflamed.

In the course of time Spectacle frames get out of proper shape, and become too loose to keep the Glasses up to the Eyes: — this arises so imperceptibly, that I have found it occur to several persons who were unconscious of it. — The Optician easily remedies this, by restoring the bend of the Sides to their original form, and new pinning the Joints of them.

Nothing can look more ridiculous, than the trick which some Idle persons have, of sus-

* The quantity of TEARS spread over the Globe of each Eye in the space of 24 hours, amounts to *Two Ounces* and upwards; *i. e.* a common sized wine-glass full. — People who make use of Spectacles have opportunities of observing, that the evaporation of Tears tarnishes very much the Circles which surround the Glasses. — Dr. P. DEGRAVERS, *on the Eye and Ear*, 8vo. 1800, p. 116. Surely the subject on which the Doctor made this experiment must have been, "like *Niobe* all Tears."

pending their Spectacles on the very tip of their Nose:—this is as injurious to their own Eyes, as it is *absurd* to the Eyes of others.

The Bridge of Spectacles *for Long-sighted Persons,* who wear them to read with, is best of the form, (shewn in the Plate) which when the Eyes are employed in Reading or Working, &c. brings the Glasses parallel to the centres of the Eyes.

For Short-sighted Persons, it should be straight—because the Glasses are required to be parallel to the Eyes when you look straight forwards horizontally.

The proper Shape for the Openings which hold the Glasses, is the true regular *Oval**—which form is similar to the Opening of the Eye.—The Vulgar opinion is, that *Circular Eye Glasses* are ground of the most perfect Figure—the Fact is, that *the Oval Eye Glasses* are ground Round at first and then clipped Oval.

The Front of the Frame should project beyond the Glasses far enough to protect the

* Spectacle frame-makers complain that the Glass grinders have a barbarous custom of distorting their Ovals, by putting in ill-shaped Glasses—and forcing the openings to adapt themselves to them.

Glasses when people carelessly lay them down on their surfaces—and also to prevent their being injured by rubbing against the Case, when passing in or out thereof.

The Front must be Strong enough not to bend in the smallest degree—or the Glasses will lose their parallelism with the Eyes, vision will be distorted, and the Sight distressed.

The whole of the elasticity of the Frame must be in the sides.

The First Joint should be of Silver wire of the $\frac{1}{15}$th of an Inch in Diameter, and Four Inches and a half in length, and so curved as not to touch the Head except by the last half inch of it. The First Joint is seldom more than $4\frac{1}{4}$ inches in length—but the apparently trifling addition of a quarter of an Inch in its length gives it a much more steady and comfortable attachment to the Head, than can be imagined by those who have not tried it—especially when the Second Joint is turned down and you use it with the First Joint only.

The Second Joint should be flat, about the $\frac{1}{8}$th of an Inch in breadth, and $2\frac{3}{4}$ Inches in length, with a loop end—and the Pin which fastens it to the First Joint should be kept tight enough to

preserve the Second Joint in whatever position the wearer finds easiest and most convenient. —If this becomes loose—it is easily tightened by placing the pin on which it turns, over a piece of Iron and giving it a gentle tap.

MEM.—If the Pin which fastens the Second Joint to the First is not rivetted very nicely and smoothly—every time You take off your Spectacles, you will find it *an Infallible Depilatory*—and if "Time has not thinn'd your flowing Hair," your Second Joint very soon will.

N. B. If the Second Joint be turned upwards to an Angle of about 30 degrees, it will be in the best position for preserving the Frame in its proper place.

PRICES OF SPECTACLES.

	£.	s.	d.
Best double-jointed silver Spectacles with Glasses	1	1	0
Ditto with Brazil Pebbles	1	16	0
Best single joint silver ditto with Glasses	0	13	0
Ditto with Brazil Pebbles	1	8	0
Double joint Steel ditto with Glasses	0	5	0
Single joint ditto	0	3	6
Ditto	0	2	6
Morocco Cases	0	1	6
Double-jointed Hand Spectacles in Pearl			

CHAPTER XV.

OF THE QUALITY OF SPECTACLE GLASSES, AND HOW TO MEASURE THEIR FOCAL LENGTH.

The defects of Spectacle Glasses are either from Veins — Specks — Scratches — Colour — or false Figure.

1st. To discover *Veins* in a Convex Glass place a Candle about 5 or 6 yards from you; then look through the Glass, move it from your Eye till you find it full of Light, and you will then clearly see every vein, &c. in it which renders Vision imperfect by distorting the Objects.

2dly. *Specks* or *Scratches* are not so mischievous as *Veins* — for they do not distort the object, but only intercept part of the Light; — however, such defective Glasses will not be used, except by such persons who think that their Two Eyes are not worth Two Shillings.

3dly. *False Figure.* To prove the Figure, lay a Book before you, hold the Spectacles in your hand, and looking through them remove them gradually from the Book. If the figure

of the Glasses is false, the objects will appear distorted and confused. Thus if you view any cross lines which form small squares, through a falsely ground glass — some of the squares will appear with strait sides distinct and all of a size; others with crooked sides of different sizes and confused; so that the whole will be neither like the original, nor all parts of it distinct at the same distance.

If you view it through a true glass, it will be exactly like the original figure and uniformly distinct, only magnified according to the degree of the power of the lens used; and as you gradually remove the Glass beyond the focus, if you take care to move the Glass perpendicular to the plane of the Paper, all parts of the object will become equally indistinct at the same distance.

4thly. *The Colour of the Glass* — That is the best material for looking through, through which Objects appear nearest to their natural Colour — the easiest way of examining the Colour of a Glass is to lay it upon a piece of White Paper.

To measure the Focal Length of Spectacle Glasses. — The usual manner

of measuring the focus of Spectacles, is to hold them opposite a window against the side of a room, and draw them gently away forwards until the frame of the window can be seen, making a small image through the Spectacle glass on the Wainscot or Side of the room. When the window frame appears most distinct, the number of inches, measured by a rule between the glass and the wall, or partition opposite, will shew the real focal length.

CHAPTER XVI.

PEBBLES.

Some folks have a notion, that "Pebbles *are much cooler to the Eyes than* Glasses:" — the relationship between "a Pebble" and "a Stone" and the Proverb "as Cold as a Stone" probably gave rise to this prejudice in favour of Pebbles.

It is quite impossible to distinguish between good Pebbles and good Glasses.

People call that Glass coolest to the Eye, which is of the most proper focus for it, and

which therefore irritates and fatigues it the least—and through which they can see easiest and best.

The only superiority of Pebbles over Glasses is, that they are not so liable to be broken; and as they cannot be scratched by any thing softer than a Diamond, they may be carried in the pocket without a Case; which are certainly great advantages, especially to Travellers and Short-sighted Persons—(See page 100) but I must warn my friend the Reader that Pebbles are so very veiny, that it is seldom a bit is found so perfect as it ought to be, and *therefore* 1 pair of the Best Pebbles cost 16s. *i. e.* as much as 8 pair of the Best Glasses.

OBSERVATIONS ON THE MATERIALS AND MANUFACTURE OF GLASSES FOR SPECTACLES,

By Mr. S. Pierce, Optician.

The best material for the formation of *Spectacle-glasses*, is the White Plate, commonly termed Dutch Glass;* it is very clear and hard, with-

* I am informed that The British Plate Glass now made in East Smithfield, is very superior to any that was formerly made in this country.—*Editor.*

out veins or specks comparatively, and bears an excellent polish: Crown-glass is too dark and seedy for the purpose; French or British Plate is more difficult to polish well, and Spectacle-glasses made therewith are generally Grey; that is, the fine grinding from the Emery is not sufficiently polished off.

Much has been said to persuade the Public that each Spectacle-glass ought to be ground and finished singly by itself, else its defects of variety of *foci*, incorrect representation of objects, and false colouring, must be considerable. But every one acquainted with Glass Grinding, is well convinced, and will be ready to assert, that a Glass of so small a diameter as an inch and a half, cannot possibly be worked so steadily, nor so true, by the hand singly, nor polished off so fair and regular, as when several are worked together in a Block: this block may probably hold four dozen of glasses, which are worked, ground, and polished together in a tool of an exact radius to produce the focal length desired. The firmness of a Block of Glasses secures you against the possibility of forming any irregular sphericity, and gives it a decided advantage.

Some years since, Spectacles were brought from Holland, the glasses of which had been heated sufficiently to receive a Concave or Convex form, by being pressed in iron Pincers or Moulds of various curvatures, without any other process:—it is easy to conceive that each Glass must have had an inequality of *foci*, extremely injurious to the sight of the unfortunate user, yet these vile glasses were almost universal throughout France and Germany.

In England it is no uncommon thing to find the Spectacle-glasses of an itinerant optician, ground on one side only, while the other side remains as it was originally cut out from the plate, without being worked at all, and, moreover, full of veins, &c. which refracting the light irregularly—distort the object and distress and greatly injure the Eye, and are as detrimental to the Eyes as the former; but the article is sold cheap, which is too often the most tempting recommendation to the million: but as a pair of the very best Glasses, which are warranted free from all imperfections, may be purchased for only two shillings—who would be so mad as to run the risk of forfeiting the fee simple of his precious Sight—for

four-and-twenty pence! for *a Groat a Year!!* for the Glasses seldom require changing oftener than once in half-a-dozen years, and sometimes not in a dozen!!!

CHAPTER XVII.

ON THE VARIOUS DEGREES OF THE PERFECTION OF THE EYE AND EAR.

GOOD, and well-educated Eyes are as much delighted with the Harmony of Colours — as fine Ears are with the Harmony of Sounds — and a cultivated Eye is as much distressed by ill-according Colours — as a cultivated Ear is offended by discordant Sounds. I well remember that excellent Musician, Dr. Arnold, telling me when I was studying composition with him, that when he first began to learn counterpoint, his Ears were so excruciated by the Chord of the 2nd of the Key — *i. e. the Sharp* 6th — that he used to call it "*the Gritty Chord.*"

It has been recorded that the Eyes of some persons have been gifted with such *Penetrating* power (as Dr. Herschell termed what I call

Illuminating power) — that they could perceive the Moons of Jupiter. — See G. ADAMS *on Vision*, 8vo. 1789, p. 64.

I have heard of, but never met with such Visual organs. — Common Eyes can scarcely perceive them with a good Achromatic Opera Glass magnifying 4 times.

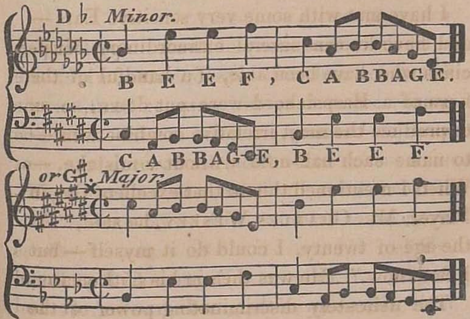
Father *Castel* invented an *Ocular Harpsichord* — which was strung with coloured tapes instead of wires, and being placed in a dark room, when the keys were touched, the transparent tapes which corresponded with them became visible. C. published a pamphlet describing this curious machine, which was translated into English, and I once had a copy of it.

I have met with some very sensitive Ears — and have known several extraordinary Musicians who have been able, if a handful of the keys of a Harpsichord were put down, so as to produce the most irrelative combinations — to name each half-note without a mistake. — When I mentioned this to that excellent Organ Player, MR. CHARLES WESLEY, he said, "At the age of twenty, I could do it myself — but I can't now." He was then in his 55th year.

The delicately discriminating power of the

Ear is more the gift of Nature than extreme sensibility of the Eye, which latter is I believe always in a considerable degree the result of cultivation.—MISS CUBITT, of the Theatre Royal, Drury Lane, when only six years old, surprised me very much, by the high degree she then was gifted with the former faculty; so was MR. WATSON, of the Theatre Royal, Covent Garden: which they still retain.

MR. T. COOKE, the Singer and Composer to Drury Lane Theatre, whom no one will contradict me when I style the most extraordinary Musician of the present Age, when I put down the following Notes on a Piano-Forte,—told me at once, "I think, Sir, that you have *Beef* in one hand—and *Cabbage* in the other.



Some Eyes are doubtless of as superior quality as these Ears.

But the other extreme is more common, of the ears being so dull and badly provided with defining powers, that their owners can hardly distinguish "OH THE ROAST BEEF OF OLD ENGLAND" from "*Buttered Pease;*" — and are more delighted with the discordant screams of their Pet Parroquet, the snarling of their Darling Dog — or some such Barbarous Uproar — than with the sweetest Melody or the sublimest Harmony — Arne or Handel ever imagined.

Sound passes through the Paste-board Party Walls of modern houses with such unfortunate facility — that the majority of the *Dogs* — *Parrots* — *Piano-fortes*, &c. in this Metropolis are — *Actionable Nuisances!!!*

I believe that many of those imperfect performances, and erroneous opinions, which are usually ascribed to the want of Skill, or the want of Industry, or *Good Sense* — would be more justly, and will be, set down to the want of *Good Senses* by those who adjust the Microscope of Criticism with Good-nature.

When I have heard the works of various Artists, of Painters, Engravers, &c. found fault with — for either bad drawing, or bad

colouring, or finishing, — I have often thought that such defects, in construction or arrangement, have been owing more to the Eyes of the Artists not being capable of shewing them how to do better — than to the carelessness, &c. which they have been inconsiderately censured for by those who had a sharper Sight. — A Good Eye, is unhappy, till every part of its work is as perfect as it can make it: — the gratification which it then receives is so superior to all other considerations, that to obtain it — Labour becomes Pleasure.

We find persons of profoundly Good Sense, have imperfect notions on some subjects, to a degree which is quite surprising until explained on these principles.

Few men are "framed so in the prodigality of Nature," as to have all their Senses in perfection — very few have a single One, that approximates within many degrees of it — the Eye of *Raphael*, the ear of *Handel*, — or the sensitive Touch of the Blind Girl who could *feel Colours* — are pancratic faculties which are seldom produced."

The peculiar Genius and Character of each Individual originates either in the exquisite

sensibility — or in the extreme obtuseness of some single Sense: — this makes one man a Painter, — another a Musician, — in opposition to all the influence which can be set up against it.

Many eminent Painters and Musicians were originally self-taught, and unable to resist the fascination of their Eye or Ear, but were so overcome by their love of their Art — that they have overcome all Obstacles, which were placed in their way to prevent them pursuing it.

I have met with Persons in whom the sense of Seeing or Hearing was so absolutely predominant, that — the other Four appeared to be totally eclipsed :

> "And hence one MASTER PASSION in the breast,
> Like Aaron's serpent, swallows up the rest."
>
> POPE.

Where Nature has given an *extremely* sensible faculty to a man, the employment thereof is more delightful and easy to him than the employment of any other, and the cultivation of it, an irresistible enjoyment.

This is *Genius* in the proper sense of the word, whether in Mind or Body — and is the super-eminent faculty which is born in man.

The possession of extraordinarily *Perfect Senses*, is by no means so enviable as people ordinarily imagine, — the works which they enable the possessors to produce can only be fully appreciated by faculties equally perfect and equally cultivated.

The purblind

> " Undelighted, gaze on all delight."

The Sagacity to comprehend, and estimate the importance of any uncontemplated improvement — is confined to the very few, on whom Nature has bestowed a sufficient degree of perfection of the sense which is to measure it; — the candour to make a fair report of it, is still more uncommon — and the kindness to encourage it — cannot often be expected from those, whose most vital interest it is, to prevent the developement of that, by which their own importance — perhaps their only means of existence — may be for ever eclipsed; and as POPE says—

> " ——————— How many are
> Condemned in Business or in Arts to drudge
> Without an Equal — or without a Judge."

Thus, the Inferiority of the Senses of others— prevents their deriving much advantage from the Superiority of their own.

When Ability and Industry have overcome the difficulties always attending the perfect execution of exquisite works, they have still to contend with the obfuscated imaginations of the Ignorant,—and the malicious misrepresentations of the Idle,—the Interested,—and the Envious,—and are seldom repaid for their exertions, unless they are content to reckon with Pope, that

> "One self-approving hour whole years outweighs
> Of stupid starers, and of loud huzzas.
> In parts superior what advantage lies!
> Tell, for you can, what is it to be wise?
> 'Tis but to know who little can be known,
> To see all other's faults, and feel our own;
> Painful pre-eminence yourself to view
> Above life, weakness, and its comforts too."
>
> Pope.

Persons who have *Bad Senses*, i. e. only just enough Ear and Eye to hear a Dinner Bell, and find a Spoon—often appear to be gifted with *Good Sense* in a very superior degree, and seem to think deeper than those who have the

External Senses in greater perfection.— When those avenues to the interruption of Intellectual abstraction, the Eyes and Ears,— are half shut,—it is reasonable to suppose, that the Thinking Faculty may be more active, and more perfect.

Those persons whose External Senses are obtuse and imperfect, are generally, close Reasoners — subtle Calculators — rigid Economists,— and in all respects Persons of exemplary Prudence.

The Insensibility, of people who have *Bad Senses,* exempts them from many diverting temptations, which assail those who *See* — *Hear* — *Feel* — *Taste* — and *Smell* in perfection.

That Paragon of *Good Sense* — Dr. S. Johnson, *was Short-sighted,* and could not see distinctly more than 4 or 5 inches from him.—

His Ears were imperfect also,— when others expressed the delight they received from Music, he said, "I should be happy to have that sense given to me;" — and when a celebrated Player had finished an elaborate Concerto, which they told him was extremely difficult,— he said— "Sir, I wish it had been impossible."

The slovenliness of his own Dress,—I dare

say arose from the defect in his Sight, preventing him from being sensible of the agreeable impression produced by proper attention to neatness in others.

We have irresistible evidence that *his Taste was defective*, — for his appreciation of a Good Dinner, was according to *the Scale which Tasteless people always measure by*, — the Variety, the Rarity, and the Costliness of it, — for he needed not Dainties to excite his Appetite; that, we are told, was sharp enough.

THE

PANCRATIC EYE-TUBE,

INVENTED BY

WILLIAM KITCHINER, M.D.

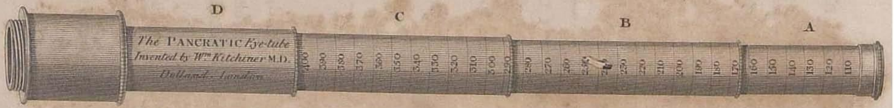
Is applicable to ACHROMATIC* *and* REFLECTING TELESCOPES *of all Lengths, and also to* MICROSCOPES.

[See an Engraving thereof opposite this Page.]

THIS EYE-TUBE is applied to the Telescope

* Those in which the Errors arising from Colorific refraction, are corrected by the figure, position, and refractive power of the Lenses which constitute the Object-glass.

The Pancratic Eye-tube.



" ε Bootis, with 270.

" α Geminorum, with 230.

As they appeared with the Pancratic Magnifier.

See Dr. Kitchiners "Economy of the Eyes," Part 1, page 130.

Published by Mess.rs Hurst

in the same manner as other Eye-tubes, and is adjusted to distinct Vision by the same Pinion motion.

For the *Lowest* Magnifying power, the Three Inner tubes must be shut up within the Outer one; — when the Magnifying power is to be increased, the smallest of the sliding tubes, A, must be drawn out to either of the numbers engraved upon it; care being taken not to draw out any part of the other sliding tubes, B and C, until the whole of *the First*, A, is pulled out; — *the Second* tube, B, may then be drawn out to either of the numbers engraven thereon; and in like manner *the Third* tube.

The numbers engraved on the Tubes, denote the Magnifying power of the Telescope.

To change the Power for any less power than the one to which the tubes have been drawn out, the reverse of the above-described mode of proceeding must be observed; — the Largest tube must be returned first, and so on, until they have been brought back to the number required.

Each alteration of the Magnifying power will require a new adjustment of the Pinion; — as the Magnifying power is increased, the dis-

tance between the Eye-glass and the Object-glass must be diminished.

"It has long been known, that the Magnifying powers of Telescopes could be augmented by increasing the distance between the two glasses next to the Eye, and the two that are next to the Object-glass, to *almost* double the power of the Eye-tube in its usual form, *i. e.* from 30 to 55. *This is the utmost that Opticians have heretofore accomplished;*— yet this variation is so desirable, that I think it only requires to be generally known, to be generally desired, both for Convenience and Cheapness*.

"A few months ago, I saw an Eye-tube, made by Mr. Cauchoix, with a scale of magnifying powers from 25 to 73; but, upon trial, I found that the vision was perfectly good only between 35 and 45.

"My attention was strongly excited by the idea of One Eye-tube effecting the whole busi-

* Before Mr. Jesse Ramsden invented, about 1785, *The Pipe-drawer* for the Terrestrial Eye-tube — and changed the Magnifying power, by changing the two Glasses next to the Eye — for which half Eye-tube he charged 10s. 6d. — for every change of Magnifying power, there was the incumbrance and expense of another Eye-tube, costing 1l. 1s.

ness of Magnifying; and after several experiments, with the assistance of Mr. S. Pierce, I combined lenses of such proportions that they admitted of being separated from each other so as to Magnify at one extremity, *more* than double what they did at the other, the vision continuing uniformly distinct.

"Having now done more than had been previously effected, I brought it to You. The approbation You expressed of what I had done, so encouraged me, that I applied unceasingly, determined to perfect the object in view, which I have now accomplished.

"I beg to present to you the following accurate measurement of the powers, and faithful account of the performance of

"The Pancratic Eye-Tube, which I think gives a better defined image of a fixed Star, — and shews Double Stars decidedly more distinct*, and perfectly separated, than any other Eye-tube, and I hope will enable us to determine the distances of these objects

* Especially in Achromatic Telescopes, which are, what is termed, a little *over-corrected*, and the purple rays predominate: that is, when the focal length of the *Convex Lens*, is formed rather too long for the *Concave*.

from each other, in a more perfect manner than has been possible heretofore.*

"This Eye-tube, when accurately made, applied to an Achromatic of 44 inches focus, produces, in the most perfect manner, every intermediate degree of Magnifying power between 100 and 400, either for Celestial or Terrestrial uses — the *Field* † *of Vision continuing uniformly distinct.*

"Therefore it is presumed, that the advantage of my PANCRATIC Eye-tube over the usual common Eye-tube, in variety of Magnifying power, — convenience, — cheapness, — and portability, — is as 300 to 1. — The cost of a common Eye-tube is One Pound; of the Pancratic only Two Pounds, Two Shillings.

"*The Tubes are graduated;* every 10 degrees, thus, 100, 110, 120, up to 400.

* This may, perhaps, be accounted for, from the greater degree of the aberration arising from the extreme sphericity of the lenses in other Eye-pieces which magnify so highly.

† It may be said that Common Eye-tubes have rather a larger field — but of what use is that part of the field in which objects appear distorted and fringed with Colour.

That, can only be considered the actual and useful field of view, the Margin of which, is as perfectly distinct as the middle of the field, when the Telescope is adjusted at an object seen in the middle of the field.

"The change from one Power to another may be made instantaneously, with the utmost facility and certainty, and the Observer always knows exactly what Power he is using."

[The above is an extract from Dr. Kitchiner's Letter to Sir JOSEPH BANKS, P.R.S., which was read at the meeting of the R.S. on the 20th of April, 1820.]

Another is made, which is adapted for TERRESTRIAL purposes, Magnifying with an Achromatic of 44 inches focus, from 55 to 200 times—and with a 30 inch from 40 to 160.

The power it will give to a Telescope, is according to the focal length thereof, and is easily found by the Rule of Three; for instance—if the Telescope be of 18 inches focus—

If a Telescope of 44 Inches gives } 55 { what will one of 18 Inches?

$$\begin{array}{r} 55 \\ 18 \\ \hline 440 \\ 55 \\ \hline 44)990(22\tfrac{1}{2} \\ 88 \\ \hline 110 \\ 88 \\ \hline 22 \end{array}$$

$22\frac{1}{2}$ the Magnifying Power with an 18 Inch.

from $22\frac{1}{2}$ times, up to 88 — being as low a power as is requisite for *Land Objects* — and as high as is requisite to shew *the Ring of Saturn*, — *the Belts and Satellites of Jupiter* and several *Double Stars*.

If the Pancratic be applied to a Telescope with sliding tubes, it is desirable, on account of the great power it produces, that it should have an *Adjusting Screw* with a tooth and pinion; these are made separate from the Telescope, and introduced between the first and second sliding tubes.

The Advantage — of having ALL *Powers in* ONE *Eye-tube* is sufficiently obvious.

In very *Clear* Days the Air is so transparent, that we can use a Power of 100 for Land Objects, and on objects well illuminated sometimes 150, as well as in some other days we can a power of 50. Telescopes act best when used in the same direction that the Sun shines.— I have known good Telescopes condemned by trying them upon objects situated towards the East in the morning, or the West in the evening.

To have Perfect Vision — every Day, and every Object, must have its appropriate de-

gree of Magnifying* power! — this can only be accomplished by the *Pancratic Eye-tube.*

On the 25th of March, 1819, Mr. Pierce, the Optician, with a Pancratic Eye-tube which made a 1 foot Achromatic magnify 80 times, perceived *α Geminorum* to be double.

On the 5th of April, 1819, I shewed this with a power of 70 to Mr. Wm. Brockedon, the Painter, and to Mr. Charles Turner, the Mezzotinto Engraver in Ordinary to HIS MAJESTY.

α Geminorum requires very little *Illuminating* Power: I have shewn it to several persons who did not know that it was a Double star, with two 1 foot portable Telescopes, with an Object-glass of the usual aperture of 1½ inch in diameter, to which I applied a *Pancratic* Eye-tube, which gave a power of 70 times, and they described to me its appearance very accurately.

I have seen these two Stars with 230 in an Achromatic Telescope of 28 inches focus, and 2¾ inches aperture, (which was made by the

* "THE EFFECTIVE POWER OF TELESCOPES has a considerable range of extent, — and can only be assigned — when the Object to be viewed is given." — Sir WM. HERSCHEL, in Vol. CV. of the *Phil. Trans.* page 294.

present Mr. Dollond for the late Mr. G. Hodgson, at whose sale in February last I purchased it,) like Two Shillings on a bit of Black Cloth— See diagram facing page 130; but in which, I beg to observe, that the smaller Star is made rather too small in proportion to the larger Star. See *Sir Wm. Herschel's* diagram of *Castor,* as it appeared in his 7 feet Newtonian with 460. in the *Phil. Trans.* for 1782.

ε *Boötis,* was observed on the 25th of May, 1819, by Mr. H. Browne, F.R.S. and myself, with an Achromatic Telescope of $2\frac{7}{10}$ths aperture, made by Mr. George Dollond, F.R.S. With a Pancratic Eye-tube magnifying 270 the two Stars, were just as perfectly and as distinctly defined, and at about the distance from each other, as represented in *the Engraving of the Pancratic Eye-tube* facing page 130, without either rings or rays, &c., around them. This was in an extremely fine clear evening — the air quite still — and the star very near the meridian. The *Blue* colour of the smaller star was remarkably bright for so small an aperture — This Double Star is *very rarely* seen perfectly distinctly, in an Achromatic with a less Aperture than $3\frac{1}{4}$, or in a Gregorian Re-

flector of less than 5 inches, and a Power of 300.

Sir William Herschel saw it in his 7 feet Newtonian when its aperture was limited to 3½ inches; with 460 the vacancy between the Stars was ½ a diameter of the smallest. See Phil. Trans. Vol. 95, p. 42.

Well might *Dr. Maskelyne* say that "Telescopes of *Sir Isaac Newton's* construction perform most excellently in the *Minutiæ* of Astronomy, especially if small Apertures and long Foci are made use of." See Supplement to the Nautical Almanac for 1787, p. 42.

Magnifying power when required for observing DOUBLE STARS, is also more perfectly effective in an Achromatic Telescope, in proportion, as it is derived from a proper degree of original power from the Object Glass — the image of the Stars appears smaller, and their separation greater.

I will here take the liberty to caution those who hereafter may be crazy with the *Dumpy**

* This appellation was first given by Mr. SHORT, the celebrated Maker of Reflectors, to a Telescope he made for the *Honourable Topham Beauclerc*, of 6 inches aperture,

Mania, that the convenience derived from Telescopes being made short, (if beyond a certain proportion,) is greatly more than overbalanced, by the errors produced by the great increase of the aberration of Sphericity arising from the deep curves of the excessively small Eye-glasses we are obliged to employ — there is much difficulty in getting deep Lenses well worked — and so much more mischievous are the errors arising from any deviation from proper figure.

It is almost impossible to find an Eye-glass so deep as even the $\frac{1}{10}$th of an Inch focus, that will give a well-defined image of a Star, notwithstanding much deeper magnifiers are useable in Microscopes.

Steady Stands are now constructed at a very moderate expense, which make it as easy

and which I saw in *Colonel Aubert's* Observatory at Highbury; it was only 24, instead of the length he usually made them, *i. e.* 36* inches focus. The instrument is well known in the Optical World by the name of "*Short's Dumpy.*"

Mr. Tulley informs me, that this Telescope is still in high preservation, and is now in the possession of *Mr. Allen*, Plough Court, Lombard Street.

* See the Supplement to the Nautical Almanac for 1787, p. 39.

to use a Telescope of 9 feet, as one of 3 feet in length.

Writing the above, reminds me of a conversation I had about 25 Years ago with an eminent Optician of great experience:—

Kit. How much more convenient short Telescopes are than long ones! I have lately bought *a Dumpy.*

Opt. Do you find it perform much better, Sir, than Telescopes which are of the usual length?

Kit. No, it certainly does not perform better.

Opt. Did you pay much less Money for it then?

Kit. No, Sir—a great deal more.

Opt. Then I think, Sir, that You have laid out your Money very badly—I guess that You have not got so good a Telescope for £30. as You might have had with half the trouble to yourself and the Optician for £20.—for You might have had the choice of half a dozen Telescopes of the usual length, and what does it signify whether the Tube is 2 or 4 feet long?—a Stand that will carry the one will carry the other; and remember, Sir, that Vision is better, and easier to the Eye—in proportion that Magnifying power is pro-

duced by Eye-glasses of long foci. — I am taking it for granted, Sir, that the Instrument is employed for important scientific purposes, when the first consideration is Optical perfection.—However, I ask your pardon, Sir, for speaking so plainly — perhaps You purchased your *Dumpy* merely for a Plaything?

I have seen ε Boötis, as distinctly as represented in the diagram, facing page 130, with a Telescope which would not exhibit a glimpse of the small Star which accompanies *Rigel*, nor the small star near *the Pole Star* — and other Telescopes which would plainly shew the latter, but failed entirely at the former.

Very few Instruments are so perfect, that they will perform perfectly well on all Objects. — There is almost always, some false light flitting about some part of the Image, and if a small Star happens to be in that part, it is enveloped therein, and is

"Invisible or dimly seen."

I do not call it *seeing* a Star Double, when you can only now and then, fancy you can *perceive* a faint glimpse of a little flitting ghost of an accompanying Star, during fits of easy

transmission — but only, when the apparent diameters of the Two Stars are as perfectly round, well defined, and distinctly separate, with a deep black division between them: as they are delineated in the diagrams in the plate facing page 130.

I have several times seen that very pretty object, γ *Andromedæ*, with 1-foot Achromatics, with an aperture of 1 and $\frac{1}{10}$th of an inch, and a Magnifying power of 35. In these little telescopes, the smaller Star which in larger instruments appears of a fine *Blue* colour — for want of illuminating power, appeared of the same colour as the larger Star. *The Blue Colour* of the Stars accompanying this Star and ε Boötis, becomes vivid in proportion to their proximity to the Meridian, and the Perfection and Illuminating power of our Telescopes.

I must here caution the Novice, that He must not often expect to see these extremely minute objects to the utmost advantage*, as I

* "For if there be any vapours moving and undulating in the atmosphere, which often happens, though the night appears clear to the naked eye, these will entirely destroy the distinctness of the appearance: and it often happens that the air in this respect, at least here with us at Kew,

have described them, when I saw them at very favourable moments with very fine Instruments — especially the Colour of the Blue Stars, even when they are near to the Meridian, and the *Illuminating* power of the Telescope is in due proportion to the *Magnifying* power, and the Instrument is *Extremely* perfect — unless *the Air is very clear and still — and every circumstance is favourable* *.

will so suddenly and so totally alter, that the object will appear very distinct and very confused afterwards in 3 or 4 seconds of time; and the air is sometimes so very variable that objects will appear instantaneously to change, from being very clear to be confused, and then to be clear again. It will therefore be proper to accustom one's self to the fluctuating appearances of some land-objects, seen in the day time through the reflector; lest the undulating appearances of the planets in the night may deceive one, and incline one to think this instrument does not succeed so well as it is certain it will in a pure undisturbed Air." — Dr. Smith's *Optics*, 4to. vol. ii. p. 366.

* "I have had recourse to my Journals to find *how many Favourable Hours we may Annually hope for in this Climate.*

"It is to be noticed, that the nights must be very clear — the Moon absent — no Twilight — no Haziness — no Violent Wind — and no sudden change of Temperature; — and it appears that *a Year which will afford* 90, or

The Astronomical Amateur should be fully aware, that such is the capricious and vibrating state of the Atmosphere of this Country, that many Evenings which seem to be extremely fine, when the Stars appear very brilliant and dazzling to the naked Eye, are quite unfit for Observation, and our best Telescopes will perform but very badly.

Sir Wm. Herschel observes, that " Double Stars require a great deal of good distinct light; or even with the best instruments, the observer must not condemn either his instrument or his eye if he does not discern them."

N.B. The apparent Diameters — and the Distances of *Double Stars** from each other, —

at most 100 *Hours, is to be called a very productive one."* ! ! ! — Sir Wm. Herschel, in page 84 of the 90th vol. of the *Phil. Trans.*

* The Reader will find, in the 26th Number of *The Journal of Science*, edited at the Royal Institution, 1822, 24 Diagrams of Double Stars, by Mr. J. South, F.R.S.

In the Second Part of the Economy of the Eyes — will be given Portraits of the *Planets*, and Diagrams of the most remarkable *Double Stars*, as they appear in Telescopes of various Magnitudes, with various Magnifying powers — stating with how Low a Power and how Small a

vary very much, — according to the different states of the Atmosphere, — the Defining, — Illuminating, — and the Magnifying power of the Telescope, and their proximity to the Meridian.

To avoid the painful position when observing Celestial objects when they are near the Zenith, I have tried all the 9 different kinds of Diagonal Eye-tubes, the respective advantages of which I shall state at large in the *Second Part* of this work; I have only space here to say, that I think that the best I have was made by Mr. G. Dollond, and consists of a Plane Speculum placed at an angle of 45 degrees between the Object Glass and the Eye-glasses, and receives all the Eye-pieces, and renders an *Achromatic* Refracting Telescope as convenient as a *Newtonian* Reflector.

The light lost in the Reflexion is scarcely perceptible when observing fixed stars—the position is not only pleasanter, but our organ of sight is more perfect, when we look comfortably straight forwards—than it is in the break-neck position required in observing ob

Telescope, the Stars may be perceived to be separate, and with What Power they are seen best.

jects in a high Altitude without such assistance. It may be urged, that a *Prism* would bend up the rays with less loss than a Speculum can reflect them — but in the latter you have only one surface to get worked truly, and it is no easy thing to obtain that quite good*— in the former you have several, and the imperfections of the glass to contend with into the bargain: — such is the intense intrinsic brightness of the fixed stars, that the inferior degree of vividness of the pencil of rays is, I may say, imperceptible.

"α Lyræ, I surmise, has Light enough to bear being magnified at least a hundred thousand times, with no more than 6 inches of aperture, provided we could have such a power, and other considerations would allow us to to apply it."

* "I find more difficulty in correcting the figure of the little *plain* piece of metal next the Eye-glass than one would expect." — See *Sir Isaac Newton's* Letter in the *Phil. Trans.* for 1672. vol. vii. p. 4032; and Sir *William Herschel's* Obs. in Octob. 12, 1782, in page 44, of the *Phil. Trans.* for 1795.—Messrs. *Watson* and *Tulley* have assured me that no figure is more difficult to make, than a perfect Plane.

See Sir Wm. Herschel, First Catalogue of Double Stars in the *Phil. Trans.* for 1782.

As Sir Wm. Herschel has remarked, "the Newtonian, as usually constructed, is admirably adapted for observation, for the Observer always stands erect, and looks in an horizontal direction, though the Telescope should be in a vertical position, and elevated to the very Zenith."—

The position it was placed in by this ingenious Astronomer is, perhaps, still more convenient.

"My Eye-glass is mounted on that side of an octagon tube, which in the horizontal position of the instrument makes an angle of 45° with the vertical—having found by experience that this position, resembling the situation of a reading desk, is preferable to the perpendicular one commonly used in the Newtonian construction—which has the capital advantage of rendering observations equally commodious in all altitudes; and you may therefore place the Instrument in the meridian, and view the stars in their most favourable position."—See *Phil. Trans.* for 1786. Vol. lxxv., p. 457—8.

I have no hesitation in saying, that in the

uncomfortable (and if long continued, painful) position required in observing objects near the Meridian with any other Telescope—no Half Dozen Observers, even if as experienced, and as expert and as indefatigable, as the IMMORTAL HERSCHEL himself, could have performed, what that incomparable Observer achieved single-handed with his 7 *Feet Newtonian.*

When we wish to discern those delicate and minute objects, which are the most interesting exhibitions our Telescopes display to us, and with the finest Instruments are only discernible with the most favourable circumstances,—we should be in a position of the greatest ease: no cramp or painful posture must distort the Body, or irritate the Mind;—the whole powers of which must be concentrated in the Eye.

Such is the sympathy between the various organs of the human body, that we may as well attempt to think accurately on two subjects at the same time, as to use two Senses at the same moment:—each must be used alone, if we wish to give it a fair chance of doing its utmost.—As *Shakspeare* has observed of Listening with such profound attention, that "each other Sense was lost in that of Hearing."

The Magnitude and Colour, of Celestial Objects, appear surprisingly different, to different Eyes.—The same Evening, that with a power of 180, the planet *Jupiter* has appeared to me to be about an Inch and a half in diameter,—a person, who observed it the next minute, said it looked as big as the Moon;—another, about Four inches diameter;—and a third, thought it did not appear quite so large as a small Pea.

"It will be necessary here to take notice, that the estimations made with one telescope, cannot be applied to those made with another. Whatever may be the cause of the apparent diameter of the Stars, they are certainly not of equal magnitude with the same powers in different Telescopes, nor of proportional magnitude with different powers in the same Telescope."—Sir Wm. Herschel, in vol. 72 of the *Phil. Trans.*

N.B. The Reader is cautioned, that my *Pancratic Eye-tube,* is composed of *Three Inner, and an Outer Tube,* and that when all drawn out, it is 14 inches and $\frac{3}{8}$ths in length;—when shut up, not more than $5\frac{1}{2}$ inches;—and that when drawn out, the magnifying power is

Quadruple, what it is when the tubes are shut up.

As I have no Interest in the sale of this Eye-tube, I have stated my opinion upon it—it is made by Mr. Dollond, and sold at £2. 2*s.*—for £1. 1*s.* more than the common Eye-tubes.

On the old Plan *Two* Magnifying powers cost £2. 2*s.*: with the Pancratic mentioned at page 134, you have *Three Hundred* for £2. 2*s.*

None are Genuine but those precisely answering the above description, and exactly resemble the engraving opposite page 130, and have the following inscription engraven on the Outer Tube:—

"The PANCRATIC Eye-tube: Invented by WM. KITCHINER, M. D."

This remark is necessary, because, *Counterfeits** are made *with only* ONE *Tube*—which have only half the variety of powers *the Pancratic* has, and consequently, magnify only

* To construct this Eye-tube perfectly, requires All care and excellent workmanship—the Lenses must be All of exactly the right focus—All without any blemish—and the Glasses and the Tubes containing them must be very truly centered with regard to each other, and to the Object Glass.

Half as low — or *Half* as high as they ought — such are only put to ordinary Telescopes, for the reason we have stated, that a low power is put to an ordinary Opera-glass.

But the Reader must not expect that every ordinary Telescope which is fitted up merely for *Terrestrial* purposes, — will properly carry for *Celestial* purposes, extraordinary high Magnifying Powers,— nothing like it; — nevertheless — such Telescopes may be perfectly efficient Instruments for the purposes for which they are made, and perform very well for *Land Objects*—there are plenty of Good Day Telescopes, — but few Superlative Star Telescopes.

To bear an uncommonly powerful Eye-glass, for *Celestial* purposes, you must have an uncommonly perfect Object-glass, and as the difficulty of forming this, increases as the magnifying power to be used with it increases — in like manner, the makers must be rewarded for their trouble, — which is greater, as the Instrument must be adjusted at a Fixed Star, — which is a much more elaborate and Eye-teazing operation than the ordinary method observed with Day Tele-

scopes, of the defining power of which, a Printed Paper is often considered a sufficient criterion.

If I was an Optician,—I think that I would almost as willingly —*Waltz blindfold and barefoot among* 9 *Red hot Ploughshares laid at unequal distances from each other,*—as have All my Telescopes tried by that truly troublesome test a Fixed Star.

When a Telescope is perfectly adjusted,—a very trifling accident—will derange it so as to prevent its properly defining a Star—although it may not perceptibly affect the brightness or distinctness of the vision of it with any other object—not even with the Planet Jupiter.

Before You condemn a Telescope because it does not very nicely define a Star,—try it several Evenings with several Eye-pieces,—and let the Maker of it (trust it with no other Person) examine whether it be in perfect Adjustment.

Defects in *Eye Glasses* are seldom suspected—but, however perfect the original power of the Object Glass or Speculum may be, it will avail little, if one of your Eye Glasses is veiny, &c., or not quite clean—or not exactly truly centred to the Object Glass. — *Sir Wm. Herschel's*

Observation in p. 31, of the 95th Vol. of the *Phil. Trans.* is perfectly true :—

"The best Eye-lens will give the least spurious diameter of a Star."

Not *One* Instrument in *Twenty* can be made to give a neat Image of a Star with its whole Aperture,—and not *Two* of Them will give quite so perfectly well defined an Image with the Whole Aperture—as when it is to a certain degree contracted.

I do not think that any Achromatic of 2¾ inches Aperture, and 3½ feet focus, can be made to give quite so neat an image of a Star with the whole of that Aperture, as a fine 5 feet of 3¾ths Aperture will when it is limited to 2¾—I have never seen one that approximated within some degrees of it.

The more perfect vision in the 5 feet, I am aware, is partly to be attributed to the greater original power of its longer Object Glass, and to its larger Eye Glasses—but what I have asserted is true of Telescopes of equal length; though the improvement is not in so high a ratio.

Whatever inexperienced Amateur Opticians may think of this declaration of "*the Cook's Oracle*,"—'tis true.

The Author respectfully assures the Reader

that these Lucubrations from his *Garret* — are the result of actual experiments; and, like those which were lately published from his *Kitchen*—are faithful statements of facts repeatedly proved.

Although he has been very cautious, in constructing every sentence with words which would express his meaning as exactly and as clearly as He could, — nevertheless, — his chief Ambition has been to give those who may do him the honour of perusing this little Book, all the Information he has accumulated, in the most convincing and most satisfactory manner; — and he has never been contented to offer a mere assertion, whenever it has been in his power to produce collateral proofs from the writings of experienced authors.

"If the Aperture of a Telescope be 5 or 6 inches, there will be required a piece of Metal 7 or 8 inches broad at least, because the figure will scarcely be true to the edges." See Sir Isaac Newton's Letter to the Secretary of the *Phil. Trans.* March 26, 1672. vol. vii. p. 4032.

It may be supposed that Speculums are now worked with more accuracy than when "the Optician's Oracle," Sir I. Newton, wrote the above; however, I have not yet seen a

Reflecting Telescope of 7 Inches Aperture which did not define Stars much better when it was contracted in a certain degree.

That excellent Optician, and candid writer, Mr. Peter Dollond, observes of his Achromatics, that "though the surfaces of the *Concave* Lens, may be so proportioned as to aberrate exactly equal to the *Convex* Lens, near the axis, yet as the refractions of the two lenses are not equal, the equality of the aberrations cannot be carried to any great distance from the axis." See Mr. Dollond's Letter to Mr. Short in the *Phil. Trans.* for 1765.

I had an Achromatic of $3\frac{6}{10}$ths Aperture, which was a remarkably brilliant Day Telescope, and with which I saw Planets very well—but could not see *Rigel* and several other delicate objects distinctly, until its Object Glass was limited to $2\frac{3}{4}$ inches—with $3\frac{6}{10}$ths—the small Star accompanying *Rigel* was enveloped in the false light from the large one—with $3\frac{3}{10}$ths inches—it was not much better—but with $2\frac{3}{4}$ inches, the little Star was very distinctly, and easily visible,—and it exhibited ε *Boötis*—γ *Leonis*, &c., better than I have generally seen them with Telescopes of $2\frac{3}{4}$ inches Aperture.

Those who have Telescopes which do not define Stars so well as they wish — may, supposing the aperture to be 2$\frac{7}{10}$ths, make a pasteboard cover for the Object end, with an aperture of 2$\frac{6}{10}$ths — and if that be too large, contract it to 2$\frac{5}{10}$ths, and so on by 10ths till the Image of a Star is neatly defined.

The best Advice I can give to *Buyers of Telescopes*, is, that — if they are particular about *the Quality* of the Instrument, the less curious they are about *the Price*, the more likely they are to be pleased with the performance of it — if they deal with an Optician of established character, and leave it to his Judgment and Integrity to choose for them — not restraining him in Price — my own experience assures them, they have then, the best chance of obtaining what they desire.

For instance, a common portable Two feet Achromatic Telescope which is made merely for Day purposes and magnifies about 30 times, is sold for £4. 4*s.*; — if this is required to carry a power of 100, *i.e.* three times the power it was made to bear; and to define Double Stars, &c. — it must have a picked Object-glass, — of a degree of perfection, which is

only attainable by a casual concurrence of the various circumstances which combine to form these Compound Object-glasses.

The Planet *Jupiter* was till within the last 30 years considered the grand test of Telescopes for Celestial purposes, — *and when it is near to the Meridian* it is a pretty severe one—but many Glasses will define a Printed Paper, and shew the *Planets* very well, which will not so well define *Double Stars,* because they were not adjusted at a Star. — Double Stars were not thought of till the attention of Astronomers was called to them by *Sir William Herschel* publishing his Catalogues in the *Phil. Trans.* for 1782 and 1785—since that time, the Art of making Telescopes has been gradually improving, and both the Optical and Mechanical parts of them are now made much more perfect than they were Twenty years ago.

For exquisite perfection, — we are, in all mechanical matters, almost as much indebted to accident, as to Art: — for instance, a Watchmaker makes a *Dozen Chronometers*, and bestows an equal degree of attention to the finishing of each of them; so much so, that he has reason to hope they will all perform equally well: how-

ever, — when put to the trial, he commonly finds, that of the Dozen, — perhaps *Four*, in spite of all his care and pains, will turn out but indifferent Watches,—*Six* of them good,— and the remaining *Two*, fine, and fit to

"Correct Old Time, and regulate the Sun."

But why Two of his Watches perform with such superior accuracy beyond the others he cannot imagine.

In every department of Art it is the same, *the Acmè of Perfection* is always accidental,— and the most experienced and pains-taking workman cannot attain it with undeviating certainty by any Rules — this Observation applies to a Telescope even more than it does to a Watch — for the Optician has not only to contend with the difficulty of workmanship — but with the greater uncertainty of the quality of the Material he employs ; and if not One in Half a Dozen Chronometers will measure Time truly — not one in a Dozen Telescopes which perform perfectly well for all other purposes, will define Double Stars sharply — and accordingly, those which will, bear a proportionately High Price.

Very few persons, however, require Telescopes for this purpose. Objects which are so severe a test of a Telescope — are as severe a trial to the Sight — and those who have due regard for their Eyes, forbear from straining them by all needless exertions.

See the account of an alarming *Dimness of Sight*, from such fatigue of the Eye, in pages 66 and 67 of this work.

CHAPTER XVIII.

OPERA GLASSES.

"Ne damnent, quæ non intelligunt."

This entertaining Optical Instrument, seems to have escaped the observation of preceding writers on Optics — the whole, of the "*Lex Scripta*" which I have seen about it, is, that "*An Opera Glass*" is like a Galilean Telescope, and composed of a concave Eye-glass and a plano-convex Object-glass — and that its Magnifying power will be augmented, in the proportion, that the focal length of the former is diminished, and that of the latter is increased.

As so little has been written on this subject — I have embraced this opportunity of endeavouring to communicate such information as I have collected concerning it.

Few Persons know even

"*How to Adjust an Opera Glass* —"

partly from the want of this knowledge, and partly from the very low Magnifying power, and imperfect construction of Common Opera Glasses — I have not been much surprised,

when I have heard people insist, that such Instruments are useless Machines,—which are made merely to be sold. Others, from not knowing how to adjust them, I have heard complain that their Eyes are always so much strained by looking through them—that they are afraid to use one.

To look through a Good Opera-glass, when it is properly adjusted,—I have not found to be more fatiguing to my own Eye,—than to look with as earnest attention—at the same Object,—for the same length of time, with my naked Eye. These mistakes of Ignorance and Impatience, would not happen so often, if the Instruments were properly constructed, and if, in the Case of every *Opera Glass,* there were pasted *Plain Directions* for adjusting it to Distinct Vision.

The irritable state of the Eyes, which some Persons complain of, after having passed the evening at a Theatre, is not a mere local affection,—but is to be attributed chiefly, to that general exhaustion of their nervous Energy, which many suffer when they do not retire to rest at their accustomed hour.—*See* pages 64, 65, and 66 of this Volume.

To give some idea of *the Focus*, Opticians sometimes draw a line round the Tube,* where it is most distinct for a Common Eye at the distance commonly required in our Large Theatres, which, *to see the Scenery in perfection*, is seldom less than about 50 or 60 feet.

When You use an Opera Glass,—hold the Outer tube in one hand, and the Inner with the other hand — and *while looking through the Glass at the Object you wish it to shew you*, ADJUST IT patiently and precisely:—thus,—press the Eye tube towards the Object Glass, Vision will gradually increase in distinctness as the Eye glass approaches its proper distance from the Object glass, and when there, the Object will be seen perfectly and sharply defined—if the Eye tube be put in beyond the proper distance,—the object will again become indistinct, and in that case, the Eye tube must be withdrawn again:—a very

* As the Reader may have observed, that the Spying Glasses which are in use at Watering Places—and at Sea—have a mark on their tube which is called *the place to set it to*—very few persons have any idea that every variation in the distance of the Object, or the Age of the person, requires a variation of the adjustment of the Glass.

little practice, will enable a person easily to obtain the precise point at which the most perfect distinctness can be obtained.—This is a much better way of adjusting an Opera Glass—than to put it up to the Eye, and then pull out the Inner tube—by which act, if the tube does not slide regularly, or is shorter than you expect, it may suddenly slip out, and strike your Eye. To prevent this—in the best finished Opera Glasses the end of the inner tube is attached to the outer tube by a spring which screws in.

The greater the Magnifying power of an Opera Glass, the greater nicety is required in adjusting it.

If You wish to see any thing 10 *or* 20 *feet further off, or as much nearer,*—for each variation of distance, a corresponding variation of ADJUSTMENT is required; *i. e.* of the distance of the Ocular Glass from the Object Glass—which must be diminished, in the proportion that the distance of the Object is increased. This caution is quite necessary—I have met with many persons who have condemned an Opera Glass—because they could only see some objects distinctly with

it, and for others they found it useless — merely, because they had not been told, that — *every variation of the Distance of the Object, requires a corresponding variation in the* Adjustment. More Opera Glasses have been condemned for the want of this knowledge than from any other cause — and more Eye and Object Glasses have been spoiled. Those who are not aware of it — suppose, that when they turn their Opera Glass to an Object to which it is not adjusted — its Glasses want wiping, and they keep rubbing, till in a little time they render them about as unfit to look through as Ground Glass.

To See an Object distinctly at any given distance, *The longer and older the Sight of the Person*, the longer the tube must be drawn out — Thus — if a person of 20 years of Age, who has *a common Eye*, has adjusted an Opera Glass with a power of 4, for distinct vision at the distance of 60 feet — and wishes to set it so that a person of 40 or 50 years of Age, who uses Convex Spectacles of 36 or 30 Inches focus, may see as distinctly with it an object at the distance of 60 feet — he must pull out the tube about the eighth of an Inch further, —

more or less, as the Eye is longer or older, and the Magnifying power, and the distance of the Object, are more or less, — or they must look through the Opera Glass with their Spectacles on.

Near-sighted People, when they wear their Spectacles, See at the same focus as persons who have a common eye — without their Spectacles the tube must be pushed in nearer to the Object Glass.

If an Opera Glass has been kept in a Cold place, it very commonly happens that soon after a person has taken it from its case, a Mist will spread itself over the Glasses, so as to prevent his distinguishing any Object. — This, arises from the cold air within the Tubes, becoming condensed on the Glasses, either by the heat of the hand or of the house, — if the Inner tube is drawn out from the Outer tube, the Mist will presently go off, and the Glasses become quite clear — without any wiping.

The best way of holding an Opera Glass.

If you put it up to your Right Eye, hold it with your Left Hand — in such a manner, that the Left Arm forms a blind before the Left Eye.

Some Fidgetty folks, when not looking

through their Opera Glass, keep ever and anon, pawing, and *wiping the Eye or the Object Glass*;—neither of these should be touched,—except when it is absolutely necessary to clean them, and then, only with a bit of soft Leather, fine Linen, or the finest Silver Paper.

The Sliding Tube soon becomes dirtied by the dampness of the hands;—to avoid this, *do not touch the Sliding Tube*, but take hold only of the Neck of the Eye-head, and adjust by that. *The Sliding tube must be wiped occasionally*, and at the same time wipe round the cloth lining of the larger tube—so that it may slide smoothly—if it will move only by fits and starts, you will not be able to adjust it accurately.

I have heard persons (unacquainted with the Laws of Optics,) complain, that an Opera Glass magnifying 4 times, has not so large a *Field of View* as a Glass which magnifies only 2—this cannot be remedied;—their only alternative, is to have a small Field distinct, or a large Field of little or no use—with a power of 4 they have in quality, what with 2 they have in quantity,—the objects which they do see, they see much more than twice as distinctly.

In 1801 there sprang up "*the Grand Dandy Opera Glass,*" *with a Great Eye glass, as big, as its Object glass!* — it was imagined, — by the Amateur Optician who introduced it, — that by increasing the diameter of the Eye-glass, the field of view was proportionately increased, — and that *the Stops** which had heretofore been placed as Sentinels to prevent the intrusion of false light, — were impertinent impediments.

The fact is, — these great Grand Dandy Eye-

* These are often opened too Large, especially in Opera Glasses made with a Single Object Glass. — As the Eye-glass should be a little Larger — so *the Stop* should be a little *(very little)* not more than $\frac{1}{20}$th of an Inch less, than the cone of Rays coming from the Object-glass.

The effect of the Stop varies according to its distance from the Object-glass.

The Diameter of the Aperture of the Stop, must be proportioned to the Degree of the Magnifying Power — the former must be contracted, in proportion that the latter is increased — if it is too large the Vision will be confused and indistinct by the intrusion of False Light, if it is too small part of the pencil of rays will be cut off.

The subject of STOPS is excellently illuminated in a Paper on "Indistinctness of Vision," caused by the presence of False Light in Optical Instruments; and on its Remedies, by C. R. GORING, M.D., in the Journal of Science, No. xxxiii. for April 1824.

glasses, actually magnified very little, and on that account had a very large Field — hold a Card with an aperture of half an inch in diameter, before the large Eye-glass — you will find the field of View as large, and the Vision as bright through that, as through the Eye-glass of an inch and a half in diameter: — or, apply a Concave of an inch and a half in diameter, which makes them magnify 4 times, and you will find that the field of view is not a hair's-breadth wider through that than it is through an Eye-glass of only half an Inch in diameter.

Vision through the Smaller, is more distinct than through the Larger Eye-glass: — the Eye is apt to wander about before large Eye-glasses, and the margin of the field of view is curved, — *Vision is perfectly distinct, — only, when you look precisely through the centre of the Eye-glass.*

I shall relate some further Observations, PRO AND CON *Concave* Eye-glasses* — when I treat on the comparative Illuminating Powers of CASSEGRANIAN, GREGORIAN, NEWTONIAN,

* See several Remarks on *Concaves* in Sir W. Herschel's paper on the Quintuple Belt of the planet Saturn. — *Phil. Trans.* for 1794, vol. lxxxiv. p. 28; and in vol. cv. p. 296.

and ACHROMATIC TELESCOPES in *the Second Part of this Work.*

The field of view in Telescopes constructed with *Convex Eye-glasses,*—is regulated, by the Stop which is placed in the focus of the 1st Eye-glass, or that next to the Eye;—the diameter of the Stop is regulated by the diameter of the 2d Eye-glass, the diameter of which, varies according to the Magnifying power used. If the Stop be opened larger than the 2d E. G. it will produce a strong Orange Colour around a very indistinct margin—*with the same Magnifying power, the field of view is the same,* whether the Aperture of the Telescope be *One* Inch, or *Three.* This is easily proved, by contracting the Aperture of a *Three* Inch Telescope to *One* Inch, when the field of view will remain the same;—you will find that the only difference in its appearance, is the diminution of the brightness of it.

But with Perspectives or Galilean Telescopes, or OPERA GLASSES which have a *Concave Eye-glass—The Field of View, when they do not magnify more than Twice, depends in a great measure on the Diameter of the Object Glass.*

If an Object Glass of an Inch and a half in

diameter, is made to magnify only twice, it will have a much larger field than an Object Glass of an Inch in diameter.

But when a Magnifying power of 4 times is applied, — an Object Glass of *an Inch* aperture, will have very nearly as large a field as one of *an Inch and a half* — but through the larger aperture, Objects will appear twice as bright, as they do through the smaller; the Illuminating power of the larger, to the smaller aperture, being as 22 to 10. — These facts any body may prove, by looking through an aperture of *an Inch and a half*, and then contracting it to *an Inch*.

Some of our most valuable discoveries have been purely accidental, — as little the result of scientific investigation as the Telescope, which was found out by Children playing with the lenses in a Spectacle-maker's workshop :— these Great Grand Dandy Eye-glasses, as big as Object Glasses, led me to consider — *what Diameter of Eye-glass and Object Glass is actually useful.*

Theoretical Opticians, — have said, — that if the Eye-glass, be as large as the Pupil of the

Eye — it will perform as well, as if it was as big as the Dome of St. Paul's.

The Opening of the Pupil of the Eye is in inverse proportion to the Brightness of the Objects presented to it — as the latter increase in Brightness, the former diminishes in Diameter, therefore—the less the magnifying power, the less the Pupil of the Eye—which is always in an inverse proportion to the bigness and brightness of the pencil of Rays from a Telescope.

The ordinary opening of the Pupil, when the Eye is turned to the Light, has been computed to very little exceed $\frac{1}{10}$th of an Inch in Diameter; See Figure 3 in the Engraving, fronting the Title, and No. 10 of the APPENDIX.

Under the idea, that the opening of the Pupil when before an Opera Glass, is of the like dimension, it has been assumed, that — no matter what be the Magnifying power, or what the Diameter of the Object Glass of an Opera Glass, an Eye-glass of $\frac{2}{10}$ths of an Inch in Diameter, would be even larger than is requisite.

My Eye, had for some time suspected the Truth of this Theory: — wishing to avail myself of the amusement of a change of Magnifying power, and to have an opportunity of illustrating its effects to others, I had a *Revolving Eye head* made like the double Head of the French Opera Glasses, invented by Mr. CAUCHOIX,* with two Glasses — one magnifying

* I have had Three very good *Achromatic Opera Glasses* made for me by this Optician, of an Inch and a half, — and One of Two Inches aperture; but the latter size is heavy, and inconveniently, and I think, uselessly large, — its Double Object Glass weighs 5 ounces, and the Instrument altogether 9 ounces, and cost £5 in Paris. — See an account of Mr. CAUCHOIX's Opera Glasses, in page 374 of the *Edinburgh Review*, for October, 1819.

MEM. I do not quote this, because I am of the same opinion as the erudite Editor of the paper referred to — my own opinion of Opera Glasses, is impartially stated, at the termination of this note.

LEMIERE, *No.* 6, *Palais Royal*, has introduced an Opera Glass with a Screw adjustment, similar to what our One foot Achromatic Telescopes in a Brass Tube on a Stand have — but the adjustment is so fine, that it is more difficult to find the exact focus with it — than it is by moving the Tube, provided that be kept clean and slides smoothly: his charge for an Opera Glass with this adjustment and an Achromatic Object Glass of an Inch and a half in diameter, magnifying 2½, is £2. 4*s.*

3, the other $4\frac{1}{2}$; the Eye-glasses were $\frac{3}{10}$ths of an Inch in diameter—and I was surprised to find, that on trying an Eye-glass of half an Inch in diameter, Vision was considerably brighter and easier to my Eye.

The Magnifying Power of an Opera Glass may be varied several different ways:

1st, By having a Concave fixed in the Eye-head which magnifies $2\frac{1}{2}$, for viewing Pictures, &c.—and another to screw on over that, which will increase the power to 4, for Theatrical purposes;

The machinery for adjusting the focus, may be as much too fine—as too coarse—The fine Screw adjustment, which still seems the best that can be applied to Gregorian Reflectors, was applied to the original 46 Inch Achromatics—but when even a power of 150 is applied to them—it is not quick enough, and the focal point is not half so easily and exactly hit, as with the more modern invention of the Tooth and Pinion adjustment on the side of the Tube.

I do not mean to insinuate, that I think the productions of our English Opticians are not equal to those of the Parisian Artists—I have had several Dozens of *Opera Glasses*, made by Mr. Pierce and Mr. Dollond, which are as elegantly formed and finished—and the Optical parts, are as perfect as Art can produce:—*For a Description thereof, see* pp. 168, 169, 172, *&c.*

2dly, By having a Concave fixed in the Eyehead which magnifies 4 — and a Convex to screw on over that, which will reduce the power to 2½. I like this last plan best, because most light is required for theatrical purposes. The additional Glass may be attached to the Eyehead by a hinge on the side; and when only one of them is wanted, the other may be turned up. The opening of the Stop in the Eyehead must be regulated to suit the deepest power: — or when that is used, a smaller Stop must be brought before the larger one, in the manner in which the Sun Glass is brought before the Eye Glasses in the 4 Eye Glass Perspectives.

I am induced to offer it as an invariable maxim,—that although there may be no use in the Diameter of *the Eye-glass* being much larger, yet, it *should be somewhat larger than the Pencil of Rays transmitted by the Object-glass* — which, when an Object-glass of 1½ Inch Diameter magnifies 3 times, will, if not cut off by the Stop,* be ½ an Inch. (*See next page.*)

* *To ascertain whether any of the Object-glass is cut off by the Stop in the Eye-tube* — adjust the Opera Glass to distinct Vision — then, take out the Eye-glass, put your

As I have before observed, it has been assumed that the opening of the pupil of the Eye, when before an Opera Glass, is about $\frac{1}{10}$th of an inch in diameter; — I believe it does not exceed $\frac{2}{10}$ths, — that the Image is brighter with a pencil of three tenths and three quarters than it is with one of three tenths, my Eye assures me is evidently true — but why the larger pencil of rays makes a stronger impression on the Eye, I will not pretend to offer any reason *—I know, it is contrary to the accepted Theory — however, it is True.

> "There are more things in Heaven and Earth, Horatio,
> Than are dreamt of in your Philosophy."
>
> SHAKESPEARE.

The Diameter of the Eye-glass, for any Opera Glass, and any Magnifying power — should be rather more than what is given, by reducing the diameter of the Object-glass into *Tenths* of Inches, and dividing that, by the Magnifying power —

Finger on the edge of the outside of the Object-glass, and look down the tube — if you can see your Finger just peeping over the edge of the Object-glass — none is cut off.

* See *Sir Wm. Herschel's* observations on Night Glasses, in page 68 or 69 of Vol. 90. of the *Phil. Trans.*

Thus: for an Object-glass of 1 Inch and a half,—or fifteen 10ths in Diameter,—if a Magnifying power of 4 times be desired, divide 15,—the number of *Tenths* the Object-glass is in diameter — by 4, the Magnifying power:—

4)15($\frac{3}{10}$ths and $\frac{3}{4}$ths, the diameter of the Pencil of Rays.
12
—
3

I would have *the Eye-glass* somewhat larger than the Pencil of Rays, *i. e.* for an Object Glass of 1$\frac{1}{2}$ inch in diameter, and magnifying 4 times, I think that my Eye sees easiest, when the opening of the Aperture in the Eye-head is about $\frac{6}{8}$ths of an Inch in diameter.

The Eyehead should be of Black Ivory, not less than an inch and $\frac{3}{8}$ths in diameter, and made concave — something in the form of an Eye-bath — or a shade on the side similar to those prefixed to the Tubes used for viewing Pictures — so that it may form a Screen around the Eye, and prevent the intrusion of any rays upon the retina, except those coming directly from the Opera Glass — this, will not only improve the Vision very much, but also render it much easier to the Eye. *(See page 86 of this Vol.)*

The average Distance, at which a Common Eye, can see distinctly, the expression of the Human Countenance (in a good light) has been calculated to be about 15 feet.

The average Distance, between the Actor and the Spectator, in the Boxes of a Theatre, is about 4 times 15 feet, *i. e.* about 60 feet — therefore, — to shew distinctly, — *an Opera Glass must magnify* 4 *times.*

The Bell Operas, which have only one sliding tube, are the best; in those which have more tubes, the centre of the Object-glass and the centre of the Eye-glass are very seldom exactly opposite to each other — and in proportion as they are Eccentric, Vision is Imperfect, and the Instrument (according to a very usual and very useful Optical phrase) is said, to be — *Out of Adjustment.*

Look with a scrutinizing Eye through *Operas which are elaborately ornamented* and have many Tubes — for it is one of those General Rules which has the fewest exceptions, that those which are so very pretty to look at, are — not seldom — mere Toys, which are made to be looked at, rather than to be looked through.

This Caution is quite needful, friendly Reader — for I think I have been as much puzzled to produce arguments to persuade my friends that *Opera Glasses* are not always to be chosen for their Tubes, as I have had to assure them that — a *Piano-Forte* will not always make good its claims, to favour from the Ear — exactly in the proportion that its external appearance happens to please the Eye.

As Ten are made of the plain mountings, to One of the other, it is, in like proportion, easy to pick out a fine one.

The majority of the Opera Glasses which are sold at Trinket and Toy-shops, magnify so *little*, and are of so *little* use — that many people who have good Eyes, say with truth, that they can see as well with their naked Eye — I have met with many who have said so to me — but, when I have shewed them *a good Opera Glass, magnifying* 4 *times, precisely tuned to the peculiar pitch of their Visual Organ* — they have All, acknowledged, with astonishment and delight, the surprising aid that their Sight received from the Eye-in-

vigorating power of Optics, which enabled them—to *See Persons in the most distant parts of the Theatre, almost as distinctly, as those who were within* 15 *feet.*

After a deliberate, and fair trial of the Magnifying powers of 3—4—5—6, &c., my Verdict is,—that for use in the Theatre, for Common Eyes, *a Magnifying power of about* 4 *times, is decidedly, the most generally useful and agreeable,*—and what is of great importance, as the Eye is sometimes before it for a long time, it is—*much easier to the Eye than a Higher Power.*

Persons who are extremely Short-sighted,—(See the Note at the foot of page 103), may find a Concave which produces a power of 5 to a common Eye, not too much for them.

It is desirable, that the Magnifying Power be as *Low as can be,* that the Field of View may be as *Large as can be;* because the latter depends partly on the former—moreover, the vapour from the breath of a large Assembly, and the Smoke from the numerous Lamps, &c. prevent our using much Magnifying power.

When I suggested my opinion of what ought to be the Magnifying power of an Opera Glass to an Optician — I was told, "It has been tried — but the less they magnify, the more people like them; and indeed, those seem to me to be most approved, which magnify so little that they scarcely require any Adjustment."

Exquisite Opera Glasses, that have no focus! — and are equally distinct, whether all the Eye-tube is pulled out, or all put in!! — or you put up the Large, or the Small end to your Eye!!! — My Optical friend added, with a smile, "You may laugh, Sir, — but every body has not time to listen to a Long Story about — Focus, — Adjustment, &c. &c. &c. — Gentlefolks don't like a troublesome thing, — that requires *Half a Minute* to set it in some particular form, before they can see through it."

Opera Glasses have been one of my favourite hobbies for the last Thirty Years — and to gain the information contained in these pages, I have carried my experiments to the greatest extent possible, for I think I have

tried almost All Apertures and All Focal Lengths — I had one Object-glass made by Mr. Pierce, of 4 Inches in Diameter — and from that Brobdignagian, he made for me all the intermediate sizes, down to the Lilliputian, which I have called my "*Invisible Opera Glass,*" whose Object-glass is only $\frac{6}{10}$ths of an inch in Diameter, and of which an account is given in page 103.

My favourite *Single Object-glass Opera Glass,* which is very portable, and very light, for it only weighs two Ounces, — has a Plano Convex Object-glass, of one inch and $\frac{2}{10}$ths in Diameter, and usually magnifies $2\frac{1}{2}$, but with a deeper Eyeglass of $1\frac{4}{10}$ths for Common Eyes, or $1\frac{3}{10}$ths for the extremely short-sighted, Mr. Dollond informed me, may be made to magnify about 4 times, and is in his Catalogue called the Middle Size Opera Glass, with a Nourse Skin tube, and mounted with dyed Ivory — its price £1 : 1.

The most effective Achromatic Opera-glass for general use, which I have seen, is Mr. Dollond's *Bell Opera of an Inch and a Half aperture, with a Power of* 4 — it is conveniently

portable, an entertaining companion at a Playhouse, and a very pleasant Prospect-glass.

If the Eye-glass is changed, for One which makes it magnify Twice, it will be an excellent Instrument to assist the Sight to view distant *Pictures at Exhibitions, &c.*, which it will shew with very beautiful effect — and *Short-sighted* persons (especially) will find it an incomparable assistant to give them *a General View of the Constellations,* — and it also deserves to be recommended as an excellent Finder to such as are fond of turning out on a fine frosty night to sweep the sky for a *Comet,* — those who are not, or have not Courage or Constitution to brave the inclemency of midnight Frosts and Damps, without which, actual Astronomical Observations cannot be made, I recommend to pay a visit to the

OURANOLOGIA,*

in which is shewn the most beautiful and perfect Orrery ever exhibited, and is one of the

* This *Lecture on Astronomy and the Phænomena of the Heavens and of the Earth,* is annually given during Lent, at the English Opera House, on a Magnificent

most Instructive Exhibitions that youth can be taken to.

"Stars teach as well as shine."
"An Undevout Astronomer is mad."

"The Heavens are telling the Glory of God, and the Firmament sheweth his handy work."

"These are Thy Glorious Works,
Parent of Good, Almighty."

"A Deity believ'd, is Joy begun;
A Deity ador'd, is Joy advanc'd;
A Deity belov'd, is Joy matur'd."

Dr. Young.

The late Astronomer Royal, Dr. Maske-

Orrery, describing a circle of One Hundred and Thirty Feet. In this immense Machine, the Sun, and all the Planets and Satellites revolving round him, are seen in motion, with their comparative Diameters and Orbits. *The Comet* of 1811, descending in its eccentric orbit towards the Sun, arriving at its perihelion, and retrograding, being an original and entirely novel mode of exhibiting and illustrating this beautiful Phenomenon.

Mr. Bartley well deserves the fame he has acquired, by the impressive manner in which he delivers his illustrations of these sublime subjects, which are expressed in terms perfectly intelligible, and spoken so distinctly, as to be perfectly audible in the most distant parts of the Theatre.

LYNE, who was short-sighted, had a *Binocular Opera Glass,* i. e. two Opera Glasses, magnifying about twice, fixed in the opening of a Spectacle frame, which he placed before his Eyes, like as you put on Spectacles. I remember seeing a pair of such Spectacles in the Observatories, of MR. LARKINS, on Blackheath Point; of MR. AUBERT, at Highbury; and of MR. HODGSON—at Hoddesdon.

For those purposes which do not require a Magnifying power exceeding $2\frac{1}{2}$*—a Single Object Glass* of $5\frac{1}{2}$ inches focus, and of $1\frac{2}{10}$ths in diameter, *is, very nearly, quite as good as an Achromatic, and costs only half as much.*

The Colorific, and Spherical Aberrations, which cause that fringe of colour, and indistinctness around the margin of the field of view of Single Object-glasses—which arise in an extreme degree, when the Aperture of a Single Object-glass, is too large, for its focal length — or the Eye-glass is too short and magnifies too much — and are sometimes so glaring when such a Glass is pointed at a highly illuminated object in the *Day time*—are often hardly, if at all, perceptible

in a Theatre, unless it be directed to the Lights. But half the errors of aberration arising from the over large apertures of Single Object Glasses are rendered imperceptible in most Opera Glasses — either by a small Stop cutting off half of the cone of rays, or the Eye Glass, or aperture in the Eyehead, not being half large enough to receive them — and while the observer imagines that his Object is illuminated by an aperture of $1\frac{3}{4}$ inches, perhaps he has, in fact, not the use of an aperture of $1\frac{1}{4}$.

Concave Eye-glasses may be had for 1s. 6*d*. *each* — and it will afford some amusement to have three or four — Magnifying 2 and 3 times, for viewing *Pictures* — 4 for *the Theatre* — and 5 or 6 as *a Perspective Glass,* for use at a Review, or on a Race-course, &c. For 15*s*. every degree of Concave may be purchased — that is from *Two* inches to *One* inch focus — proceeding by *tenths* of inches: thus — any one who is anxious to give his Eye all the assistance that Art can afford it, may readily do so to the utmost nicety.

The following Rules will serve for ascertain-

ing the comparative degrees of the Magnifying Power of several Eye Glasses, although, gentle Reader, you may think that the 1st — is one of the completest Paradoxes you ever met with.

1st. "*The more a Glass Magnifies, the more it Diminishes;*" — *i. e.* if you have two *Concaves*, or *Convexes*, and wish to know which magnifies most — hold one in each hand, about one foot from your Eye, and about five feet from a window frame — the Lens through which the panes of Glass appear *least*, — magnifies *most:* — this is the readiest way of ascertaining the comparative power of various Lenses.

2nd. The further the Eye-glass requires to be removed from the Object-glass, and the more the Inner tube must be drawn out — the more the Eye-glass magnifies. If an Opera Glass magnifies 3, and the Eye-glass is changed for a concave which is a little deeper to make it magnify 4 times, to obtain distinct vision the tube will require to be drawn out further.

The Double Object-glass before-mentioned is an Inch and a Half in Diameter; its length, when in use, when it magnifies 4 times, is about 4 Inches; and with its tubes weighs

3 and $\frac{3}{4}$ Ounces; — a larger Glass is cumbersome to carry, — an unsightly machine to use; — and the additional Illuminating and Magnifying power gained by a larger aperture and longer focus — are in a Theatre, of very little, indeed I think of no use.

There is no need of a Magnifying power of more than 4 times — nor of a pencil of rays of more than three tenths and three quarters in diameter, which is given by an Object-glass of an inch and a half in diameter.

That *the Field of View* is considerably larger through an Object-glass of Two inches in diameter, if the Magnifying power be as much as 4 times, is *a Vulgar Error.*

The increase of the field of view in the larger Object-glasses is comparatively very trifling, and much more than counterbalanced by their unwieldy weight and length. — Moreover, the difficulty of making Object-glasses, as their diameter is increased, increases in so high a ratio, that those of Two inches, very rarely define Objects so perfectly and sharply, as those of an Inch and a Half in diameter.

In every department of Art, the *acmé* of

perfection is always partly accidental, and is not to be attained with undeviating certainty by any Rules; and as there are 100 of 1½ made for 1 of 2 inches aperture—it is in the like proportion, more easy to select a Fine One.

Imperfections in the Object-glasses of Opera Glasses, like those of Telescopes, are magnified and become evident, as the Magnifying power of the Eye-glass is increased.

Defects in an Object-glass which, when it magnifies only *Twice*, are almost imperceptible—when it Magnifies *Four* or *Five* times, become too glaring to pass muster before a good Eye—the Vision, (especially the margin of the field of view,) becoming less Sharp, and the edges of the Objects being fringed with Colour.

Opticians charge £2. 12*s*. 6*d*. for the Best Achromatic Opera, in a plain mounting, with an Object-glass of 1½ inch in diameter and which magnifies 4 times — £2. 2*s*. for the Common Achromatics, which magnify 2½—and £1. 1*s*. for those of like power with Single Object-glasses.

I must here caution my Reader, that the real, or the relative powers, of various *Opera*

Glasses, can only be accurately appreciated by actual trial in the Theatre, in which they are to be used—especially, comparisons of Achromatic and Single Object-glasses; and unless particular care be taken that they are glassed with precisely the same kind of Glass — with Concaves which give precisely the same Magnifying power — and the Glasses are directed to the same Object, at, as nearly as can be, the same time ; and the Ocular Glasses and Object-glasses are all perfectly clean — Comparison will be in vain.

The difference of even 3½ and 4 in the degree of Magnifying, will, with some objects, give quite a different character to an Opera Glass, — even if the Object-glasses and Eye-glasses are equally good.

An inexperienced person, will say that the Opera Glass which magnifies 4 times, *defines* some objects more *distinctly* than that which magnifies only 3½ — but that there is a greater degree of *brightness* about the latter, and that the vision in it appears *clearer :* — This, is thus to be accounted for, — *the lower the Power,* the clearer and brighter objects appear — and up

to a certain maximum, (which I think for use in a Theatre is about 4 times,) *the higher the Power* the better minute objects will be defined, and the sharper and more distinct the Vision will appear.

The Achromatic Object-glass above-mentioned, is composed of a *Plano Concave* lens, and *a double Convex*,* which, combined, are generally (in every part) of the thickness of about $\frac{3}{8}$ths of an Inch.

The thickness of the usual *Plano Convex Single Object-glass* of the like focus, — in the central and thickest part of it is seldom more than $\frac{2}{8}$ths of an Inch, and in the thinner parts, not half that: — however, such is the

* Sometimes *a Film or Fog forms between the Object-glasses*, or, as the Optical phrase is, "the Glasses sweat:" — when this happens, they must be taken out of their cell and wiped with a bit of soft Leather or of very fine Silver Paper — but never do this but when it is absolutely needful — and then, take care to replace them in the same position; it is seldom requisite oftener than once or twice in a Year. Nor wipe the Object or Eye-glass except they really require it — as often as you wipe them — you scratch them a little.

advantage of the *Achromatic* — that if you compare *a Single*, and *a Double* Object-glass of $1\frac{1}{2}$ inches in Diameter and $4\frac{1}{4}$ inches focus, and put to them Eye-glasses which make them magnify 4 times, you will find that Vision, (excepting just in the centre of the field of view in the Single Object-glass), is more distinct, and objects are more sharply defined through the Double, than they are with the Single Object-glass. If you contract the aperture of the Single Object-glass to $1\frac{3}{10}$, you will find the Errors of Aberration considerably diminished — and more so if you limit it to $1\frac{2}{10}$ths, and if the focal length of your Single Object Glass is increased from $4\frac{1}{2}$ to 6 Inches, its vision will be still more improved. If its aperture be $1\frac{2}{10}$th, the opening of the Stop must be limited to a little less than $\frac{3}{10}$ths of an inch in diameter.

Tenths the Object-glass is in Diameter.

Mag. Power 4) 12 ($\frac{3}{10}$ths, Diameter of the
12 Pencil.

The Chromatic and the Spherical aberrations

which produce prismatic colours, and distort the Vision in the Margin of the field of view,—exceedingly distress the Eye, and which are *the main Evil of Single Object-glasses* which have a larger aperture in proportion to their focal length than an aperture of $1\frac{2}{10}$ths inches, to $5\frac{1}{2}$—and which magnify more than 3 times, are in a great measure corrected in *Double* Object-glasses, with which the Image of Objects appears more Distinct, in proportion as the order in which the Rays proceed is better preserved.

The Grand superiority of the Double or as it is commonly called *Achromatic Object-glass*, consists in the field of view being almost quite as distinct at the margin, as it is in the centre, and thus, Vision is made easy to the Eye, with a considerable Magnifying power.

The Eye, is sadly puzzled, how, to adjust itself with a Single Object-glass, when it magnifies more than 3 times—(especially if its focus is less than $5\frac{1}{2}$ inches and its diameter more than $1\frac{1}{4}$), which then becomes indistinct, except just in the very centre of the Field. I think that *in the very Centre of the field*

of a Single Object Glass, the vision is quite as vivid, if not more so, than it is in a double Object Glass — but as only just the very middle of the field is distinct—looking through it, soon becomes much more fatiguing to the Eye than with a Double Object Glass.

Those who wish to prove this, may get a Single Plano-Convex Object-glass for five shillings, of exactly the same diameter and focus as the Achromatic one I have recommended in page 174, — and judge for themselves. If Vision is distinct, when the Single Object-glass is at the same distance from the the same Eye-glass, as when the Double one is used, the Magnifying power will be the same — if the Eye and Object-glass must be brought nearer together — the Magnifying power is less, and the Single Object-glass is of too short a focus — *to have a fair comparison,—the focal length of each Object-glass, must be exactly the same.*

For a Single Object-glass, to be at the same distance from the Eye-glass as a Double One of the same focus, the Eye-glass must be brought, apparently, full $\frac{2}{10}$ths of an Inch

nearer to the Single Object-glass—to make up for the Double Object-glass projecting so much further up the Tube than the Single One does.

I formerly thought, that for use in a Theatre, the Single Object-glass was best.

Until Mr. PIERCE, about Five Years ago, just before he retired from business, made me an Achromatic Opera-glass, which magnified 4 times, I had not seen a Double Object Glass, nor do I think one had been made, which magnified more than 2½, which is the power usually put to those commonly sold.—My own excellent Single Object-glass, which Mr. P. made for me, magnified rather more than 3½—it is no wonder then, that I preferred it to the ineffective Double ones which only magnified 2½.

The reasons why Opera-glasses were formerly not made to magnify more than 2½—were, that the small size of the Theatres at the time these instruments were originally invented, did not require more magnifying power,—and that with such a low power, the imperfections in vision arising from the Spherical and Colo-

rific aberration of the Single Object-glasses of the very large* Apertures, with which it has been the fashion to make them latterly, were comparatively trifling—indeed, an Opera-glass seems hitherto, to have been considered as *a Pretty Thing to Look at,—or a Play Thing to Look through*—rather, than—AN USEFUL AND ENTERTAINING INSTRUMENT TO SEE WITH,—its Proper Powers have never before been explained—with such Low powers, they were easy to Opticians to make, and to their Customers to use.

I feel no awkwardness in publishing this recantation of my former Opinion respecting Single Object Glasses—but willingly embrace this welcome opportunity of acknowledging my Error—to want the Candour to do so,—would be to want the Courage to confess that I am wiser To-day, than I was Yesterday,—remembering the excellent Advice given by *Pope* in the 368th and following lines of his Essay on Criticism.

* The origin of these *Great Single Object Glasses* of so short a focus, was an attempt at an imitation of the *external* appearance of the *Achromatic Opera Glass.*

—— "Positive, persisting Fops we know,
Who, if once wrong, will needs be always so;
But You, with pleasure own your Errors past,
And make each day, a Critique on the last."

To measure the Magnifying Powers of Opera Glasses:

Look at one object at the same time with both Eyes, — one eye viewing the object through the Glass — and the other without it.

You will find some difficulty at first in keeping both Eyes open in this unusual way, while looking through the Glass; but after a few trials you will be surprised at the great accuracy and ease with which the Powers can be ascertained.

The Object to be viewed, must not be more distant than what the naked eye can distinctly define; and not less distant than 60 or 80 feet. For this purpose, the best Object to be viewed, is perhaps the front of a building of regular stone work, with indented horizontal joints: or when such an object does not readily occur, a building of good regular brickwork will in general be found to answer tolerably well: other objects, as the squares of glass in a long window, which

are usually of the same size, will be found convenient for the small powers that are usually applied to Opera-glasses.

It will be obvious, from what has been said, that the object to be viewed must consist of a number of equal divisions in the height. These divisions must be regarded by one eye through the Opera-glass at the side and close against the object as seen by the other eye; and the number of divisions seen by the naked eye in the height of one division as seen through the Glass, is of course the Magnifying Power.

The foregoing process gives the Magnifying power in whole numbers. It is, however, desirable sometimes to ascertain the power of an Opera-glass to the fraction of one quarter: this may be done by marking every fourth course of brick-work with a chalk line; and the number of these chalked divisions and the additional joints of brick-work seen with the naked eye, in the space of one chalked division as seen through the Telescope, gives the Magnifying power in whole numbers and quarters.

The Magnifying Power of any Object Glass of an Opera Glass, is in proportion to its dis-

tance from the Eye Glass—as I have before observed. Therefore — a person who is so *Short-Sighted* as to use a Concave No. 4, does not derive that degree of advantage from an Opera Glass, that a *Common Eye* does—the same Opera Glass which only magnifies 3½ for him,—will magnify 4 for a *Common Eye*, and for a *Long Sighted Eye* of 60 Years old, which requires convex Spectacles to read with, of 18 Inches focus, it may magnify 4¼ or perhaps rather more.

Short, and Long Sighted Eyes when they look through an Opera Glass, with their Spectacles on—will see at the same focus, and consequently with the same Magnifying Power as *Common Eyes* — and *without Spectacles* the *Near Sighted* will have about, or almost, half a degree *less*,— the *Long Sighted*, about as much *more* Magnifying Power. The exact Focal length of the Eye-glass which is best for any peculiar Eye, will be best determined by Experiment. See page 170.

LASTLY — take care that the front edge of the cell containing *the Object-glass* projects at least the 10th of an inch beyond the surface of

the middle part of the Glass — that it may be properly defended when laid down; and that it may not be soiled by the stuffing in the top of the case coming against it; this said stuffing is a mighty silly decoration, and much better omitted — if the inside of the top of the case be required to be double natty — let it be lined with bright green Velvet.—*The Eye-end* should be sufficiently distant from the *Eye-glass* to prevent any thing touching it.

Diagonal Opera-Glasses. — To the object end of an Opera-glass may be attached a plane mirror, placed at an angle of 45 degrees, like the small speculum in a Newtonian Telescope: if this be well made, and the lateral aperture is as large as the Object-glass, the Illuminating power is so sufficient, that the light lost by the reflexion is almost imperceptible, and the Diagonal, is almost quite as bright as the Direct vision.

This is an entertaining Optical Plaything, with which, you may observe distant objects, as unobservedly, as you can those which are near with *the Circumspector*, mentioned in page 84 of this work — as the Instrument points to

a different object from that which is viewed—and as there is an aperture on the side, it is almost impossible to guess which way you are observing.

However trifling in value, or however imperfectly expressed the foregoing Observations I fear are in many respects, notwithstanding the extreme labour and care I have bestowed in order to be accurate and intelligible—I hope, that my Reader will give me credit for having done my best, to put him into complete possession of all the "Practical Facts" which I have been able to accumulate.

Of the many "Castles in the Air," which Theory has built at the expense of Truth,—there are none more numerous, or less substantial, than those which have been set up by Speculative Opticians.—I have not aimed at amusing the Imaginations of such Ingenious Persons with abstruse Algebraic calculations,—or of amazing the Reader with a confounding crowd of cramp Technical terms which are only intelligible to Practical Opticians—by

which, if some Writers have succeeded in exciting

"Wits and Philosophers, Scholars and Conjurers,"

to admire their amazing erudition — it has been at the unwise expense, of rendering their works entirely useless to the Public.

The humble efforts of the Author, have been confined, to an ingenuous 'Endeavour to give a plain unvarnished account of the actual results of his experience, in so clear a manner that — All may easily and exactly Understand.

Truths interesting to All, should be told in Terms intelligible to All.

Errors, and Omissions, will no doubt be found, and from enlightened Readers, — will meet indulgence — They, — know, — how unavoidably, — and how often, — such defects, will escape the most persevering industry, and most unremitted attention.

Those who are already well acquainted with the subject, which I have devoted many an hour to illuminate so plainly, that I hope All may understand, may think I have upon some matters, been tediously minute, — but, if I had

not written so fully and so plainly — I could not have enjoyed the main gratification I receive from publishing this little book—the pleasure, of hoping, that it will give an attentive Reader, in a Few Hours — what the Writer, has been collecting Many Years.

"Content, if hence th' unlearn'd their wants may view,
The learn'd reflect on what before they knew:
Careless of censure, nor too fond of fame;
Still pleas'd to praise, yet not afraid to blame;
Averse alike to flatter, or offend;
Not free from faults, nor yet too vain to mend."

Pope.

CHAPTER XIX.

THEATRES.

I am informed that the distance from the front of the opposite Boxes to the Curtain is —

At the English Opera House	-	50 Feet.	
Drury Lane	- - -	60 —	6 Inches
Covent Garden	- -	63 —	—

I am I believe correctly informed, that at the Theatre which Garrick rebuilt in *Drury Lane,* and where he established his immortal fame, *the distance from the Front Boxes to the Curtain was not more than* 47 *feet* 6 *inches,* — and am disposed to attribute no small part of the great admiration which I hear that he excited in those who saw him act, and who speak still of the extraordinary distinctness with which he spoke, and of the variable and incomparable expression of his Countenance, — to the Spectators being so much nearer to the Stage.

I understand from the best authority, that

at the cotemporary Theatre of *Covent Garden**, the distance of the Spectators from the Performers was then 8 feet further, *i. e.* 56 feet—and that the disadvantage of this greater distance, was then frequently remarked and complained of.

"In most theatres, whoever wishes to have a tolerable view of the Stage, must be situated beyond the reach of the Actor's voice—but if he wishes to be near the Stage, he is (in the Boxes) miserably seated sideways—I am confident, that where the distance of 70 feet from the Scene to the opposite Boxes is exceeded, the Actor will be heard very imperfectly.

"It is an universal custom to take *the point of Sight for the Scene Painting*—at the centre of the front of the opposite boxes; and this, not only for the flats or end scene, but for the side scenes also, in which it is necessary, in many instances, to represent one continued

* "In this Theatre, 1 foot 9 inches was the whole space allowed for seat, &c. though a moderate-sized person cannot conveniently sit in less space than that of 1 foot 10 inches from back to front, nor comfortably in less than 2 feet."—G. Saunders, *Treatise on Theatres*, 4to. 1790, p. 84.

line, such as the side of a Room, &c.; in which case, the least remove from the centre breaks this line and weakens the effect of the scene. This demonstrates that our painted Scenes can be viewed to a proper advantage in one situation only; and that they will appear defective in proportion as they are viewed at a distance from this point.

"It has often been observed, that if we view a person at a greater height than an Angle of 45 degrees, the features appear distorted and the expressions grimace.

"To discern well the motions of the features, we cannot be too near the Actor: it is with great difficulty we comprehend them at the distance of 75 feet, and scarcely with satisfaction at more than one-third of that distance.

"OF THE EXTENSION OF THE VOICE.

"Having traced a Circle of 100 feet in diameter, I placed the speaker in the centre; the distance, therefore, was the radius of 50 feet every way — the hearer moving in the circumference of this circle, heard most distinctly when in front of the speaker, not much less so

on each side, but scarce at all behind, and contrary to the common notion, that Sound ascends further than it descends — that

"The Descension *of Sounds exceeds* the Ascension."

Exp. 2. — "The Well-hole of the Staircase in St. Paul's Cathedral, which is free of any redundancy of sound, is about 8 feet in diameter, encircled by a stone wall, and covered with a skylight. At some distance from the bottom, and near the top, were alternately placed Speaker and Hearer; when the Voice descending was heard at the distance of 80 feet, ascending 70 feet." — From the interesting *Treatise on Theatres*, 4to, 1790 (published by Taylor at the Architectural Library in Holborn), pages 91, 2, 4 and 6: this entertaining Volume gives a Description, and the Plans and Dimensions, of all the principal Theatres in Europe; and in which those who desire further information on such subjects, will find it both minutely and plainly set forth.

I attribute Mr. Garrick's superlative success, to his proximity to his Audience. I cannot imagine, that there is any Part which *the English*

Roscius of that day played,—but that several of our present excellent Actors perform quite as well.

If our Actors appear to fail in any part, it arises from no other cause than occasionally being obliged to overstrain their Voice, (which cannot be done without some distortion of the features,) from being *at Drury Lane* 13,—and at *Covent Garden* 15 feet 6 inches, further from the Audience than in Mr. Garrick's Theatre—the very superior illumination given by the Argand lamp foot lights, side lights, &c. and the Brilliant Gas light Chandeliers which are suspended from the centre of the Ceiling, in a great measure counteract the disadvantage of the increased distance, as far as the Eye is concerned, especially when it is assisted by a good Opera Glass.

The Magic power, which some Performers seem to possess, of making themselves heard distinctly all over the House, without any apparent effort—depends infinitely more on the faculty they have of catching and caging the intense attention of the whole Audience—than upon any extraordinary exertion of their Voice.

In Mr. Arnold's Theatre, the distance between the Performer and the Spectator is only 2 feet more than it was in Mr. Garrick's House.

The following accurate account of the Building of the present Drury Lane Theatre will, I think, be as interesting to the Reader as it is honourable to the Judgment and the Integrity of Mr. Benjamin Wyatt, the Architect who built it.

The Amount of the Original Estimate for the present Drury Lane Theatre, as designed by Mr. Benjamin Wyatt, was £118,850, calculating on the work being completed on the 31*st of December*, 1812.

It being subsequently decided, that the Portico and the external Composition upon every front, excepting the West front, should be omitted, the Estimate was reduced to the sum of £112,750; those Items having stood in the original Estimate at the sum of £6,100.

After the Estimate had thus been reduced to the sum of £112,750, certain extra works were decided

upon, which *(previously to such decision)* were computed at - - - - - - £11,540

During the progress of the work it was decided that the Theatre should be opened to the Public on the 10*th of October*, instead of on the 31*st of December*, 1812, as at first intended; the additional expense arising from which alteration was calculated at the sum of - - - - £1,500

Making, together with the foregoing sum, a total of - - - - - - - £13,040 above the reduced Estimate.

Which sum of £13,040 added to £112,750, (the amount of the reduced Estimate) makes a total of - - - £125,790 which was the precise sum actually paid for the Building; so that in fact *the Proprietors*

never were subjected to One Shilling of expense for the Building beyond the amount at which it was estimated; although, from the alterations above stated, in the work executed, the Estimate was, from time to time, either diminished or augmented.

The Building was commenced on the 21st of October, 1811, and opened to the Public on the 10th of October, 1812, a period of little more than eleven months.

	Distance from the Curtain to the Front Boxes.	Number of Persons the Seats in the Boxes will contain.	The Pit will contain.	The Lower Gallery.
At the English Opera House, in 1823.	Feet. 50	700 at 5*s.* £175	650 at 3*s.* £97 10	400 at 2*s.* £40
Drury Lane, in 1823.	60—6	1134 £396 18	700 £122 16	500 £50
Covent Garden, in 1821.	63—	1000 at 7*s.* £350	700 at 3*s.* 6*d.* £122 10	500 at 2*s.* £50
Haymarket, in 1823.		750 at 5*s.* £187 10	400 at 3*s.* £60	320 at 2*s.* £32

For the above Calculations I am indebted to Mr. Arnold, Mr. Winston, and Mr. James Brandon.

" When His Majesty went to *Covent Garden Theatre* on February 7th, 1821, the Performances were *Twelfth Night* and *Harlequin and Friar Bacon*—Twelve Hundred People paid to the Boxes — but there is not Sitting room for more than a Thousand."—*Mr. J. Brandon,*

The Upper Gallery.	Total Number of Seats.	Money.	Private Boxes.
250 at 1s. £12 10	2000	£325	In the Private Boxes, 160 Persons.
300 £15	2634	£584 14	16 Family Boxes, 124 Persons, 24 Private Boxes, 192 Persons.
300 at 1s. £15	2500	£537	26 Private Boxes, 172 Persons.
200 at 1s. £10	1670	£289 10	14 Private Boxes, 98 Persons.

late Box Book-keeper to *Covent Garden Theatre.*

When His Majesty visited *Drury Lane Theatre* on Monday, the 1st of December, 1823, every part of it was crowded to excess — but I could not learn the exact number of the Spectators.

When The King went to *Covent Garden Theatre,* on Wednesday the 3d of December, 1823, the Performances were *The Cabinet* and

Timour the Tartar, and the number of Persons who paid to the

Boxes	- - - - - -	1936
Pit	- - - - - - -	1123
Gallery	- - - - - - -	776
Upper Gallery	- - - -	420
		4255

exclusive of *Private Boxes.*

The above account was given to me by *Mr. Robertson, the Treasurer to Covent Garden Theatre.*

It appears by this Document, that such was the universal and earnest desire of HIS MAJESTY'S Loyal Subjects to behold their GRACIOUS SOVEREIGN — that a greater number of Persons assembled in the Theatre on that Evening, than had ever been within it on any previous performance: the whole scene was most brilliant.

"GOD! SAVE THE KING"

was sung several times. Many appear to have taken much pains to shew — *When* our favourite National Anthem was *composed,*—I have endeavoured to shew — HOW it ought to be SUNG* with

"Good Emphasis and Good Discretion."

* Never having seen a Complete Score of "GOD SAVE

See No. 4. of "the Loyal and National Songs of England."

Perhaps the latter information, may be as useful as the former—for I remember to have read in "*The Cook's Oracle*," that — "it is no matter how Good your Meat is, — if it is not well Dressed."

I believe, I am entitled to the honour of having given the first hints which have been written, as to *How what is Sung so often ought always to be Sung.*

"*The Words being marked with proper Emphasis* — it is presumed will infinitely heighten the effect, and may be a standard for the per-

THE KING" for a full Band, Vocal and Instrumental, — I have given one, and have marked the Words as they ought to be expressed, in "The Grand Selection of THE LOYAL, NATIONAL, AND SEA SONGS OF ENGLAND, published in Commemoration of the Coronation of KING GEORGE THE FOURTH, and most humbly Inscribed, and with Gracious Permission dedicated to THE KING'S MOST EXCELLENT MAJESTY by William Kitchiner, M.D.

Printed for Hurst, Robinson, and Co. Booksellers to His Majesty, No. 90, Cheapside, and No. 8, Pall-mall, in which is now first printed, from the Original MS. in the possession of the Editor, DR. JOHN BULL'S "God sabe the Kinge" — A.D. 1616, and a Fac-simile of the earliest printed Copy of "God save the King" (1745) and 110 other LOYAL, NATIONAL, and SEA SONGS of ENGLAND.

formance of it — and *ensure, the proper pronunciation of the Words, and the effective expression of the Music;* and revive that harmonious combination of them, the want of which has long been deplored, — by all who have faculties to comprehend how great is their power when united, and

"Sound is married to immortal Verse." — MILTON.

"As soon as this is generally considered, Singers will see their readiest road to fame, is to avail themselves of the double power of making the words an appeal to the Hearts and Understandings of their Auditors—as well as attacking their Ears with Volutas and Cadences, &c.

"To produce effect on others—Actors must themselves feel the passion they wish to inspire their audience with—and to sing with proper and effective expression, must give to every Syllable, and to every Quaver, its exact relative value; but not *SHOUT* and *BAWL* upon *From—To—Of—In—And—But—On,* &c. &c. merely, because they happen to be placed (improperly) under the accented part of the Bar, or under a long note,—or a favourite note in their voice.

"MELODY is the soul of Music—POETRY is the soul of Melody—the warbling of Sounds

without the distinct articulation of words pronounced with proper accent and emphasis does not deserve to be called *Singing*:—it is merely playing upon the voice—a *Concerto on the Larynx*, and comparatively, as uninteresting as a Frame is without a Picture. Briefly—THE ART OF SINGING EFFECTIVELY—is to *Sing every word with the same Accent and Emphasis as You would Speak it* *.

* "The Pupils of our excellent English Composer Dr. ARNE, were remarkable for their proper pronunciation.—It will be thought almost incredible when I relate that all the fine and clear pronunciation of the words which distinguished the late Mr. Kennedy, natural as it appeared, was the entire effect of hard up-hill application of the Doctor's lofty conceptions of what was calculated to touch the Hearts and Understanding of the Auditors. This immense difficulty was often accompanied by tears and sobbings, as impossibilities; but ARNE knew otherwise, and 'Omne tulit punctum.' I say it is inconceivable what lights the Doctor threw on the accentuation of each Word, nay on every Letter of every word, whether commencing or finishing with either vowels or consonants, so as to render the sense of the Song intelligible to the most common ears as well as to the most refined. He would pass whole mornings, and never give up the Idea, that *the Poetry of a Song ill expressed* was a Nullity to the Understanding, instead of a Blaze of Light; and thus he succeeded with the British Public."—(*Literary Gazette.*)

In singing "GOD! SAVE THE KING," if every Syllable be sung, as it commonly is,

"GOD save great George our King,"

these words are pronounced as if they were spelt—

Gaw-od say-eev grey-eat Jaw-orge ow-er Kee-ing;

thus making Monosyllables into Dissyllables.

"If the proper pronunciation be preserved, it must be thus—

GOD! save great George our Kin'g;

the only syllables in this line which should be sung, the time indicated by the notes, are—GOD! save—and—George.

"*This Solemn Invocation to the* ALMIGHTY! as commonly sung, sounds more like *a Song* of Triumph,—than *a Prayer* for the preservation of our SOVEREIGN—hardly a word of it, except the first and last line, is heard distinctly.

"How much would the effect of this Loyal Anthem be increased, if the name of GOD! was uttered with due reverence!!! And if Singers would consider, that "GOD save the King," is not a florid Song,—but an Anthem,—

and like other Anthems admits of hardly any ornament beyond an Apogiatura—

" *Sing ye Praises with Understanding.*"

PSALM xlvii. ver. 7.

Instead of vying with each other, which shall introduce most Trills — Shakes, &c. let us try who can most distinctly articulate every Syllable — and most effectively utter every Word!

" *The Loyal Anthem,* is not a singular example of the want of the coincidence of the Musical, and the Prosodical Accent.

" It is almost impossible to point out a Song, that can be sung, exactly, as it is set down, from this want of the coincidence of the Rhythms of the Poetry and the Music,—which it is no easy task, even to Singers of superior ability, to adjust perfectly—so as to give full effect to the Poetry; and, at the same time, preserve the Melody." — See *Observations on Vocal Music and Singing**.

The following is *a Specimen of the manner of marking the Words* which it is recommended to Composers to avail themselves of, as a means of avoiding false Accent and Emphasis of the Poetry they are going to set — and to Singers,

* Printed for Hurst and Robinson, No. 90, Cheapside, 12mo. 1821, price 4s.

to *mark the* ***Words*** of Songs (as they would speak them) *before they think about the* ***Tune,*** which will enable them to correct any little errors of accent, which may have inadvertently occurred in Songs already set to music. This may almost always be accomplished without any detriment to the Melody, and to the infinite improvement of most Songs.

Gōd! sāve Greàt Geōrge, oŭr Kìng,
Lōng lìve oŭr Nōble Kìng,
Gōd! sāve the Kìng;
Sēnd Hīm vĭctōrĭoŭs,
Hàppy̆, and glōrĭoŭs,
Lōng tŏ reīgn ōvĕr ŭs.
Gōd! sāve the Kìng.

2.

Ō Lōrd, oŭr Gòd! ărīse,
Scàttĕr hĭs ènĕmìes,
And māke thĕm fāll;
Cŏnfoŭnd thĕir pòlĭtĭcs,
Frùstrāte thĕir knāvĭsh trìcks,
Ŏn Thēe, oŭr hōpes are fìx'd,
Ō sāve ŭs āll.

3.

Thy̆ chōicest gìfts ĭn stōre,
Ŏn Geōrge bĕ pleās'd tŏ pōur,
Lōng māy Hè reīgn;
Mày Hē dĕfènd oŭr Lāws,
And èvĕr gīve ŭs cāuse,
Tŏ sīng wĭth Heārt and voīce,
Gōd! sāve the Kìng.

APPENDIX:

RESPECTING SPECTACLES.

No. I.

RULES FOR CHOOSING SPECTACLES. BY G. ADAMS, OPTICIAN.

"When the eye sensibly flattens, all delay is dangerous; and the longer those who feel the want of assistance, defer the use of Spectacles, the more they will increase the failure of the eye: there are too many who procrastinate the use of them, till at last they are obliged to use glasses of 10 or 12 inches focus, instead of those of 36 or 40, which would otherwise have suited them; thus preferring a real evil, to avoid one that is imaginary. Mr. Thomin mentions several deplorable cases of this kind, particularly one of a lady, who, through false shame, had abstained from wearing Spectacles so long a time, that at last it was impossible to suit her, but with those adapted to eyes that have been couched. Whereas the in-

stances are numerous of those who, by using glasses of a long focus at the first approach of Short-sightedness, have brought back their eyes to their natural sight, and been able to lay aside their spectacles for years.

These considerations point out clearly the advantages that may be obtained by a proper choice of spectacles on first wearing them, and the importance of making such a choice; as the eye will endeavour to conform itself to any improper focus, and thus be brought into a state of extreme age, at a much earlier period than would have happened had they been suited with judgment. There are very few Opticians but what must have seen instances of those, who by habituating their eyes to too short a focus, or too great a magnifying power, have so injured those tender organs, as to deprive them of future assistance from glasses. This frequently happens to those who purchase their spectacles of hawkers and pedlars, men equally ignorant of the science of optics and the fabric of the eye.

"Let it, therefore, be carefully remembered, that magnifying power is not the point that is most to be considered in the choice of

Spectacles; but their conformity to our sight, their enabling us to see distinctly, and with ease, at the distance we were accustomed to read or work, before the use of Spectacles became necessary: or, in other words, glasses should so alter the disposition of the rays, at their entrance into the eyes, as will be most suitable to procure distinct vision at a proper distance; an end of the highest import, as in this respect it places the aged nearly on a level with the young, and enables him to read a common print with ease, at a period when, without assistance, he could hardly distinguish one letter from another." — G. ADAMS *on Vision*, 8vo. 1789, p. 105.

No. II.

MR. G. ADAMS' OBSERVATIONS ON SHORT-SIGHTEDNESS.

"It is generally supposed, that the *Short-sighted* become less so as they advance in years, as the natural shrinking and decay of the humours of the eye lessen its convexity, and thus adapt it better for viewing distant objects: but among the great number of *Short-sighted* that I have accommodated with glasses, I have ever found the reverse of this theory to be true, and their eyes never required glasses less Concave, but generally more Concave as they grow older, to enable them to see at the same distance."— G. ADAMS *on Vision*, 8vo. 1789, p. 126.

"I have found it necessary, in some instances, to give Convex Glasses to the Short-sighted when very far advanced in age, not because their Eyes were grown less convex, but to give them more light, and counteract an extreme contraction of the pupil."— IBID. p. 127.

No. III.

OPTOMETERS.

Dr. Porterfield invented an Instrument for measuring the focal distance of the Eye, which he called an *Optometer*. — See *Edinb. Med. Ess.* Vol. IV. p. 85.

This *Optometer* has been considerably improved by Dr. T. Young, and has been made by Mr. W. Cary, of the Strand, and is easily applicable for the purpose of ascertaining the focal length of Spectacles required for Myopic or Presbyopic Eyes.—See an Account thereof in Dr. Young's interesting Lecture on the Mechanism of the Eye in page 36 of the *Phil. Trans.* Vol. XCI.

This ingenious Instrument is a valuable succedaneum to a person residing at a distance from an Optician: — but when the choice of Glasses can be obtained, the plain plan I have laid down in Chapter X. is more accurate, and more satisfactory.

No. IV.

DR. SMITH'S RULES FOR CHOOSING SPECTACLES.

"51. In order to determine the properest Glasses for defective eyes, the distance from the eye, where an object begins to appear confused, should be found — by measuring the least distance from which a *Long-sighted* person can read a newspaper distinctly and readily: and likewise by measuring the greatest and the least distances from which a *Short-sighted* person can read small print readily." — DR. SMITH'S *Optics*, *Rem.* p. 8.

"Those Glasses are the properest for defective Eyes, which are the least *Concave*, or the least *Convex* of any that will answer the purpose of distinct vision." — Ibid. p. 8.

"58. Thus, any person may be fitted with the properest Glasses though he lives at a distance from the shops where they are sold, by sending their focal distances computed by the foregoing rules. But if choice of Glasses be at hand, they may be better fitted by trial; observing only to use those Glasses which

are the least *Concave* or the least *Convex* of any that will fit the eye. For since they cannot be put quite close to the eye, the less any glass is *Concave*, the less it diminishes the pictures of any objects upon the retina. It will also accustom the eye to that conformation of its coats and humours, which is proper for seeing objects as far off as it can; and consequently may prevent the eye from growing more Short-sighted.

"On the other hand the less any glass is *Convex*, the less it magnifies the pictures of objects upon the retina; and also obliges the eye to that conformation, which is requisite for seeing the objects as near as it can. Both which may prevent the eye in some measure from growing more and more Long-sighted."—Page 9.

No. V.

Reasons why Elderly Persons want Spectacles to read or work with. — By Dr. Jurin and Dr. Smith.

Indistinctness in Old Men's Eyes, how caused, and how mended by Convex Glasses.

"88. If the humours of the eye decay by old age, so as by shrinking to make the cornea and coat of the crystalline humour grow flatter than before, the light will not be refracted enough, and for want of a sufficient refraction will not converge to the bottom of the eye, but to some place beyond it — and by consequence will paint in the bottom of the eye a confused picture; and according to the indistinctness of the picture, the object will appear confused. This is the reason of the decay of sight in old men, and shews why their sight is mended by Spectacles. For the *Convex* glasses supply the defect of plumpness in the eye, and by increasing the refractions make the rays converge sooner, so as to con-

vene distinctly at the bottom of the eye, if the glass has a due degree of convexity.

"89. The contrary happens in SHORT-SIGHTED men whose eyes are too plump. For the refraction being now too great, the rays converge and convene in these eyes before they come to the bottom, and therefore, the picture made in the bottom, and the vision caused thereby, will not be distinct, unless the object be brought so near the eye, as that the place where the converging rays convene may be removed to the bottom, or that the plumpness of the eye be taken off, and the refraction diminished by a concave glass till it come to a due figure." — DR. SMITH'S *Optics*, 4to. Vol. I. pp. 27 and 28.

"Elderly persons do not see so well at small distances as those of less age. This happens partly from the shrinking, and partly from the rigidity of the *Cornea*, which increases with our age, and may carry out the nearest limit of *Perfect Vision* from 3 or 4 inches, as in children, and from about 5 or 6 inches in young adult persons, to 20, 30, 40 inches, or a greater distance; and in this case the eye has no assistance in viewing near objects but only

from the contraction of the pupil, and this is not sufficient for *Distinct Vision,* unless in a strong light."

"If the arc of the cornea shrink $\frac{1}{200}$th part of an inch, this will remove the natural distance from 15 to 77 inches: and the *cornea* being now grown more rigid, the *uvea* will be less able to contract it into a greater convexity. While the *cornea* was more flexible, the *uvea* was able to render it so convex as to reduce the natural distance from 15 inches to 5, that is to a third part: but now probably the new natural distance of 77 inches can hardly be reduced to less than one half, that is to 38 or 39 inches.

"Now this is probably the case of many persons above 50 years of age, and particularly my own, not to have perfect vision at a distance less than 38 or 39 inches."—DR. JURIN'S *Essay on Vision,* at the end of DR. SMITH'S *Optics,* p. 148.

No. VI.

CURIOUS EXPERIMENT.

"Into the rings of a pair of common Spectacles let two pieces of Stained Glass of different colours be fixed; and if these Spectacles should be worn in the common manner, it is evident, that over one of the retinæ will be diffused rays which excite some other colour: and the consequence will be, that neither colour will be singly perceptible, but that some intermediate colour will be seen. — If the Eyes are alternately closed, so as to exhibit the Two Colours singly, one succeeding the other, — and immediately after both Eyes be kept open, the intermediate colour will be very perceptible."

"If a *Blue* and a *Yellow* glass are placed one before the other, and applied to one Eye, the appearance will be that of a full *Green;* but if the same glasses should be applied one before each Eye, as in the experiment of the Spectacles or tubes, the colour will be *Green* diluted with much white light, or a pale Green;

for when the Glasses are placed one before the other, the two in this position intercept much more light than when they are separate; and this for a reason which must be obvious to all who are acquainted with Optics. — Dr. Crisp *on Vision,* 8vo. 1796, pp. 161 and 166.

No. VII.

DR. WELLS ON THE CHANGES WHICH THE VISION OF SHORT-SIGHTED PERSONS UNDERGOES FROM AGE.

" It has been very generally, if not universally, asserted by systematic writers upon Vision, that the Short-sighted are rendered by Age fitter for seeing distant objects than they were in their Youth. But this opinion appears to me unfounded in fact, and to rest altogether upon a false analogy. If those who possess ordinary Vision, when young, become, from the flatness of the cornea, or other changes in the mere structure of the eye, Long-sighted as they approach to old age, it follows, that the Short-sighted must, from similar

changes, become better fitted to see distant objects. Such appears to have been their reasoning. But the course pursued by nature seems very different from that which they have assigned to her. For, of four Short-sighted persons of my acquaintance, the ages of whom are between fifty-four and sixty years, and into the state of whose vision I have inquired particularly: Two have not observed that their vision has changed since they were young, and two have lately become, in respect to distant objects, more short-sighted than they were formerly. As the manner in which this change has occurred is unnoticed, I believe, by any preceding author, I shall here relate the more remarkable of the two cases.

"A gentleman became Short-sighted in early life, and as his profession obliged him to attend very much to minute visible objects, he, for many years, wore spectacles with Concave glasses almost constantly, by the aid of which he saw as distinctly, and at as great a variety of distances, as those who enjoy the most perfect vision. At the age of fifty, however, he began to observe that distant objects, though viewed through his glasses, appeared

indistinct, and he was hence led to fear, that his eyes were affected with some disease. But happening one day to take up, in an optician's shop, a single concave glass, and to hold it before one of his eyes, while his spectacles were on, he found, to his great joy, that he had regained distinct vision of distant objects. With regard to such objects, therefore, he had lately become shorter-sighted than he had formerly been. But along with this change, another occurred of a directly opposite kind. For when he wished to examine a minute object attentively, such as he used to see accurately by means of his spectacles, he now found it necessary to lay them aside, and to employ his naked eye. He had become, therefore, in respect to near objects, longer-sighted. The power, consequently, in this gentleman, to adapt the eye to different distances, is either totally lost or much diminished; but the point, or small space to which his perfect vision is now confined, instead of being the most remote to which he could formerly accommodate his eyes, as is commonly the case with the ordinarily sighted, when they are becoming old, is now placed *between*

the two extremes of his former range of accurate vision. The eyes of the other short-sighted person, a physician of considerable learning, whose vision has been altered by age, have been affected in a similar manner, but not in so great a degree.

"The only change which had occurred from age, in the sight of such of my acquaintance as were considerably myopic, was a lessening, on both sides, of their range of perfect vision." —From Dr. WELLS, *on Vision*, in the *Phil. Trans.* Vol. CI. p. 385.

No. VIII.

MR. JAMES WARE THE OCULIST'S OBSERVATIONS RELATIVE TO THE NEAR AND DISTANT SIGHT OF DIFFERENT PERSONS.

From the 103d Vol. of Phil. Trans. p. 31.

"THE fact that *Near-sightedness* most commonly commences at an early period of life, and Distant-sightedness generally at an advanced age, is universally admitted. *Near-*

sightedness generally comes* on between the ages of ten and eighteen. The discovery of it most commonly arises from accident; and, at first, the inconvenience it occasions is so little, that it is not improbable the imperfection would remain altogether unnoticed, if a comparison were not instituted with the sight of others, or if the experiment were not made of looking through a Concave glass."

"It should be remembered, that for common purposes every Near-sighted Eye can see with nearly equal accuracy through two glasses, one of which is one number deeper than the other; and though the Sight be in a high degree more assisted by the deepest of these than by the other, yet, on its being first used, the deepest number always occasions an uneasy sensation, as if the Eye was strained. If, therefore, the glass that is most concave be at first employed, the Eye, in a little time, will be accommodated to it, and then a glass one number deeper may be used with similar advantage to the Sight; and if the wish for enjoying the most perfect vision be indulged,

* It is generally observed as soon as persons begin to use their Eyes in earnest. — W. K.

this glass may soon be changed for one that is a number still deeper, and so in succession, until, at length, it will be difficult to obtain a glass sufficiently concave to afford the assistance that the Eye requires.* p. 34.

"Although old persons lose the power of distinguishing correctly near objects, and require for this purpose the aid of convex glasses, they usually retain the sight of those that are distant, as well as when they were young. Instances, however, are not wanting, of persons advanced in life, who require the aid of convex glasses to enable them to see near, as well as distant objects. p. 43.

"My own case," Mr. WARE observes, "militates against the common observation, that, as Near-sighted persons grow older they become

* I have observed, that most of the Near-sighted persons with whom I have had an opportunity of conversing, have had the right eye more near-sighted than the left; and I think it not improbable, that this difference between the two eyes has been occasioned by the habit of using *a single concave hand-glass;* which, being most commonly applied to the right eye, contributes, agreeably to the remark above-mentioned, to render this eye more near-sighted than the other.

less Near-sighted; since my Eyes, on the contrary, are more Near-sighted, at the age of fifty-five, than they were at twenty-five, and I am now obliged to employ deeper concave glasses than I then used to see distant objects, though I am not able to see distinctly through them things that are near.

"The alteration which has taken place in my range of vision, I have reason to believe, is not unusual.—The following is an instance of this kind, that is still more remarkable. Mr. L., sixty-six years of age, who has spent a great part of his life in the West Indies, and whose sight, when he was young, enabled him to see both Near and Distant objects with great precision, began, at the age of forty, to experience a difficulty in reading and writing. He immediately procured convex Spectacles of the first number sold by Opticians, which glasses are usually ground to a focus of forty-six* or forty-eight inches, and by the aid of these he continued to read and write with ease (distinguishing perfectly in the usual way all distant objects without them,) until he was fifty. At this time he first began to perceive

* Read thirty-six.—W. K.

an indistinctness in the appearance of things at a distance; and, on trying with different glasses, he discovered that, by looking through a double-concave glass of the sixth number, (which is ground to a radius of eight inches on one side and eleven inches on the other,) he was enabled to see distant objects distinctly. He has continued to use glasses of this description, for the purpose of seeing distant objects, from that time to the present; but is obliged to remove them whenever he reads, and still to employ the first number of a convex glass. — In this instance a presbyopic was changed to a myopic sight, without any known efficient circumstance to produce it. p. 47.

" In addition to these cases, I beg leave to add the information I have received from an eminent Mathematical Instrument-maker, about fifty years of age, who has long made use of convex glasses to assist his sight in reading. He tells me, that when he has been employed many hours together, for several successive days, in looking through a double microscope that magnifies twenty-eight times, (in order to enable him to mark the degrees on a small brass plate,) he has afterwards been

able, repeatedly, for a few weeks, to read without his glasses; but then the amendment gradually ceases, and he is soon obliged to return to the use of the same glasses that he had worn before."

No. IX.

AN APPENDIX TO MR. WARE'S PAPER ON VISION. BY SIR CHARLES BLAGDEN, F.R.S.

In Vol. 103 of Phil. Trans. p. 110.

"MR. WARE states in his Paper, that Near-sightedness comes on most frequently at an early age; that it is more common in the higher than the lower ranks of life; and that particularly at the Universities, and various colleges, a large proportion of the students make use of concave glasses. All this is exactly true, and to be accounted for by one single circumstance, namely, the habit of looking at *near* objects. Children born with eyes which are capable of adjusting themselves to the most distant objects, gradually lose that power soon after they begin to read and write; those who are most addicted to study become

Near-sighted more rapidly; and, if no means are used to counteract the habit, their eyes at length lose irrecoverably the faculty of being brought to the adjustment for parallel rays. Of this I am myself an example, and as I recollect distinctly the progress, it may not be useless to record it here.

"When I first learnt to read, at the usual age of four or five years, I could see most distinctly, across a wide church, the contents of a table, on which the Lord's Prayer and the Belief were painted in suitably large letters. In a few years, that is about the ninth or tenth of my age, being much addicted to books, I could no longer read what was painted on this table: but the degree of Near-sightedness was then so small, that I found a watch-glass, though as a meniscus it made the rays diverge very little, sufficient to enable me to read the table as before. In a year or two more, the watch-glass would no longer serve my purpose; but being dissuaded from the use of a common concave glass, as likely to injure my sight, I suffered the inconvenience of a small degree of myopy, till I was more than thirty years of age. That inconvenience, however, gradually though slowly increasing all the time, at length

became so grievous, that at two or three-and-thirty, I determined to try a concave glass: and then found that the numbers 2 and 3 were to me in the relation so well described by Mr. WARE; that is, I could see distant objects tolerably well with the former number, but still more accurately with the latter. After contenting myself a little time with No. 2, I laid it wholly aside for No. 3, and, in the course of a few more years, came to No. 5, at which point my eye has now been stationary between fifteen and twenty years. An earlier use of concave glasses would probably have made me more Near-sighted, or would have brought on my present degree of myopy at an earlier period of life. If my friends had persuaded me to read and write with the book or paper always as far from my eye as I could see; or if I had occasionally intermitted study, and taken to field sports, or any employment which would have obliged me to look much at distant objects, it is very probable that I might not have been Near-sighted at all. Possibly the persons who become Near-sighted, by having constantly to adjust their eyes to near objects, may not usually change to be Long-sighted by Age." p. 111.

No. X.

FROM DR. HERSCHEL'S PAPER ON THE POWER OF PENETRATING INTO SPACE BY TELESCOPES.

[In Vol. XC. of the Phil. Trans. p. 49.]

"THE APERTURE OF THE PUPIL OF THE EYE in different persons differs considerably. Its changes are not easily to be ascertained; but we shall not be much out in stating its variations to be chiefly between 1 and 2 tenths of an inch. Perhaps this may be supposed under-rated, for the powers of vision in a room completely darkened will exert themselves in a very extraordinary manner. In some experiments on light, made at Bath, in the year 1780, I have often remarked that, after staying some time in a room fitted up for these experiments, where, on entering, I could not perceive any one object, I was no longer at a loss, in half an hour's time, to find every thing I wanted. It is, however, probable that the opening of the Iris is not the only cause of seeing better after remaining long in the dark, but that the tranquillity of the retina, which is not disturbed by foreign objects of vision, may

render it fit to receive impressions such as otherwise would have been too faint to be perceived. This seems to be supported by telescopic vision, for it has often happened to me in a fine winter's evening, when at midnight, and in the absence of the Moon, I have taken sweeps of the Heavens, of four, five, or six hours' duration, that the sensibility of the Eye, in consequence of the exclusion of light from surrounding objects, by means of a *Black Hood* which I wear upon those occasions, has been very great; and it is evident that the opening of the Iris would have been of no service in these cases, on account of the diameter of the optic pencil, which, in the 20 feet telescope, at the time of sweeping, was *no more* than the 12th of an inch.

"The effect of this increased sensibility was such, that if a star of the 3d magnitude came towards the field of view, I found it necessary to withdraw the eye before its entrance, in order not to injure the delicacy of vision, acquired by long continuance in the dark. The transit of large stars, unless where none of the 6th or 7th magnitude could be had, have generally been declined in my sweeps, even with

the 20 feet Telescope. And I remember, that after a considerable sweep with the 40 feet instrument, the appearance of *Sirius* announced itself at a great distance, like the dawn of morning, and came on by degrees, increasing in brightness, till this brilliant star at last entered the field of the telescope, with all the splendour of the rising Sun, and forced me to take the eye from that beautiful sight. Such striking effects are a sufficient proof of the great sensibility of the Eye, acquired by keeping it from the Light. p. 54.

"On taking notice, in the beginning of sweeps, of the times that passed, I found that the eye, coming from the light, required near 20 seconds before it would be sufficiently reposed to admit a view of very delicate objects in the telescope; and that the observation of a transit of a star of the 2d or 3d magnitude would disorder the eye again, so as to require the same time for the re-establishment of its tranquillity.

"The difficulty of ascertaining *the greatest opening of the Eye* arises from the impossibility of measuring it at the time of its extreme dilatation, which can only happen when every thing is completely dark."

No. XI.

SNOW SPECTACLES.

THESE appear as if formed of half the Marrow-bone of a Leg of Mutton, and are worn by our untutored fellow creatures, to guard their Eyes from the glare of light from the Snow. See page 91.

The following are the dimensions of a pair which were lent to me, and correspond very nearly with those mentioned at page 110.

Length of Front $4\frac{6}{10}$ths.

Breadth across it $1\frac{2}{10}$ths.

Distance between the Eye slits $1\frac{3}{10}$ths.

The Eye slits in length $1\frac{3}{10}$ths.

Ditto in breadth $\frac{1}{10}$th.

The part which answers to the knuckle $\frac{4}{10}$ths.

They are fixed on the head by skin Straps about an Inch broad, which also serve to defend the Eyes from *side* light.

THE END.

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